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THE EUROPEAN WILD BOAR IN THE CHEROKEE NATIONAL FOREST, TENNESSEE

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The European wild boar is one of the principal game species on the Cherokee National Forest. Approximately 100,000 acres of that forest were set aside as the Tellico Fish and Game Management Area on July 1, 1936. In order to determine the proper management practices, a study had to be made of the wild boar to determine its habits and relation to the rest of the animals on the area. The following information was secured by the author during a study of 3 months' duration, made for the U. S. Forest Service during the summer of 1937.

The Game Management Area is located in the southern division of the forest in the southeastern part of Tennessee. It is a cooperative project of the U. S. Forest Service and the Board of Conservation for Fish, Game and Wildlife of Tennessee.

With the exception of a few remote scattered places and a relatively small area at the upper ends of the North and Tellico rivers, the entire area has been logged over during the last 30 years. Since reproduction is very good on most of the area, there is an abundant supply of game food. The area, much of which is very rugged, ranges in elevation from 1550 feet to 5550 feet. Other national forest lands and large private holdings block in the game management area very effectively. Highways are scarce and are so arranged that traffic can be controlled very easily. Since it is expected that the surrounding properties will soon be included in a similar game management project, the control of poaching should be relatively easy. The area is well removed from large centers of population. The nearest cities of any size are Knoxville and Chattanooga, which are respectively 70 and 72 miles dis-

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tant. All of the above facts make the area an ideal place to demonstrate the value of wildlife management. Furthermore, there is a fairly good stock of desirable game species such as turkeys, grouse, bob-white quail, deer, bears, raccoons, and wild boars on the area. For these reasons it should not take long to produce desirable results.

The European wild boar was one of the species introduced by a group of English sportsmen headed by George Gordon Moore of New York. Mr. Moore promoted the idea of having a large hunting club for English sportsmen financed by funds subscribed by them. Bonds were sold to these gentlemen and the proceeds used to build a large clubhouse and other buildings near Hooper Bald in North Carolina. A large tract was inclosed by a high fence and the wild boar was one of the species liberated in this inclosure. Due to the rapid expenditure of funds and the failure of various attempts to stock different species, the venture failed. Wild boars were introduced in the spring of 1912, the original stock coming from northern Germany, probably the Harz Mountains. The number of individuals introduced, and even the number of different forms concerned, are matters of some controversy; however, it seems reasonable to credit the story told by Cotton McQuire, who was caretaker of the hunting club for years, which is midway between the extremes. According to Mr. McQuire, about 15 wild boars of both sexes, all of the same race, were introduced. The animals were kept in a large inclosure for a period of 8 to 10 years without being disturbed, so that they could increase in number.

About 1920, an attempt was made to hunt the animals within the inclosure, using horses and spears. The animals became excited and broke down or jumped the fence at several places, escaping into the open woods. The number that escaped was estimated as 100. Since their escape the wild boars have roamed the mountains for a considerable distance. Domestic hogs were running wild in much of this area and cross-breeding occurred freely, as it has in Europe for many decades (Wilhelm Keissling, "Jäger und Jagd im Dritten Reiche," p. 33, 1936). They had been hunted freely by the natives, with the use of dogs, from that time until the game management area was established (July 1, 1936). According to some persons the wild boar became numerous on the forest, in spite of this hunting, until some 5 years ago (1932) at which time there was an epidemic of hog cholera among domestic swine that wiped out many of the wild boars as well.

Much more time than that available during the past summer would be required to make a census of a species so elusive as the wild boar, especially during the summer months. The best estimate that could be made indicates the present population as 115 animals, and these were distributed over an area exceeding 50 square miles. Since much of the adjacent area of North Carolina is also populated with wild boars, there is a continuous drift in both directions across the state line. The boar population is more scattered in

that section, but the total number would probably about equal that on the game management area. This would make a total of about 230 wild boars in the region.

Full-blooded stock is in the minority, and all degrees of intergradation between the wild boar and the feral domestic pig are represented in the present population.

Physical characters.—The European wild boar (*Sus scrofa*) which was introduced into this area is a large powerful animal reaching a height of over 3 feet at the shoulder and a weight of 400 pounds. Some German writers give a much greater maximum weight, e.g. Eberhard von Riesenthal ("Die Guete Deutsch Weydewerk Allewege," p. 16, 1925) said: "Weights up to 300 kilograms and usually 150 to 200 kilograms before dressing." This would mean weights up to 661 pounds, and usually 331 to 440 pounds, before dressing.

The body is built somewhat like that of a buffalo, being higher and heavier in the shoulder region. The high and erect mane on the neck and along the spine over the shoulders accentuates this difference, causing the shoulders to appear much higher than the hips. The hips are lighter and more angular than in domestic swine. The head is long, ending in a slender, mobile snout. (See figure 1.) The ears are small, more pointed and very heavily haired. The tail is long and mule-like, with a large tuft of long hair at the tip. The canine teeth are well developed in both sexes and in the males these become large, upwardly-directed tusks, as shown in figure 1. The front feet are somewhat larger than the hind feet. The skin is thick, as in domestic swine, and in the males becomes greatly thickened over the shoulders, forming what is known as the shield. The pelage consists of coarse bristles similar to those of the domestic hog but much heavier, and develops into a pronounced mane of long, heavy bristles from the top of the head along the spine to the region of the hips. In the winter coat the bristles are much longer, reaching a length of 5 inches in the mane, and are supplemented by a dense undercoat of fine, curly, wool-like hair.

To quote Wilhelm Keissling (loc. cit.): "The normal color is light to dark grey, although there are regions in which the vigorous wild boar are coal black in the winter coat becoming silver grey on the head. Color varieties of brown and piebald (black and white) hogs have been observed." This description seems to fit the specimens examined from this forest. The prevailing color of the adult is a grizzled dark gray. Natives report two colors represented on the forest; one as mentioned, and the other a sandy or rusty brown.

The present stock on the forest varies in physical characters from the above description to the various breeds of domestic stock that have run wild here.

Field characteristics.—A list of characteristics has been worked out to assist in distinguishing the wild boar from the domestic hogs and to dis-

FIG. 1

FIG. 2

FIG. 3

FIG. 1. The head of an adult boar killed on the area in 1936.
FIG. 2. A pitch pine tree showing rubbing and tusking injury.
FIG. 3. A young pitch pine killed by repeated rubbing and tusking.

tinguish the tracks of hogs from those of deer. Hog tracks can be distinguished from deer tracks because the hoof is much rounder and the dew claws are imprinted unless the ground is very hard. In very soft places the dew claws of deer may be imprinted; however, in deer they are directly behind the toes, while those of hogs are placed more lateral to the toes. The dew claws of hogs are pointed, not rounded as in deer.

Wild boars have a narrower hoof than domestic swine; their legs are longer and their tracks farther apart.

The trail of the wild boar is narrower than that of the domestic, the tracks being made almost in a single line. The tracks of the domestic hog are offset, forming two lines or a single zigzag line. The wild boar will run or jump up banks too steep and high for the domestic hog to climb. The wild boar is a good jumper and will leap over obstacles such as down logs, that the domestic would go around or under. Wild boars frequently cross streams by walking across down logs, while domestics would go through the stream. Wild boars are much taller than domestic swine. Therefore, the height to which trees are muddied may be good evidence of identity.

There is a difference in feeding sign, as explained under feeding habits.

Physical characteristics of the boars themselves that are distinctive may be listed as follows: The front feet are considerably larger than the hind feet. The ears are short, erect and very well haired in wild boars (figure 1). The shoulders are higher and much heavier than the hips. The head is long and very pointed. The tail is long and mule-like, with a large tuft of long hairs at the tip. Wild boars have a well developed mane from the top of the head to the point of the hip. The hips are angular and relatively light. In the winter coat the bristles are supplemented by an undercoat of fine, curly, wool-like hair. In the males the tusks are exceptionally well developed. The young pigs are striped longitudinally. In large boars the skin is greatly thickened over the shoulders to form a heavy shield. The body is narrower and carried higher from the ground than in the domestic hog. The legs are longer and stronger. The snout is longer and more mobile than in the domestic swine.

General habits.—The wild boars have many habits that are similar to those of the domestic hog. They are more alert and wilder than even the feral domestic swine, which renders them very difficult to observe. Their senses of smell and hearing are very highly developed and they rely much more on these senses than on sight. Their habits are determined in part by their environment and environmental conditions. Until July 1, 1936, the wild boars on this area had been hunted relentlessly by the natives, who used dogs freely. As a result the species is now one of the wildest on the forest, and the most difficult to observe. It occupies the remote and inaccessible places, and under present conditions is primarily nocturnal.

Daily habits.—Daily habits change with the local conditions and with the

season of the year. At present (1937), after years of being hunted, the wild boar does most of its feeding and traveling under the cover of darkness, and spends the day in wallows or in beds on the side of a ridge. According to Wilhelm Kiessling (loc. cit.): "The purely nocturnal and wandering life is not in the least characteristic for the hog. They very soon give up those habits if one gives them peace or they are well fed." If that observation is correct, the wild boar should become more diurnal on this area under the protection now afforded it. The field observations indicate that when feeding in an area that furnishes abundant cover, such as blackberry thickets, boars remain active throughout the day. When in more open areas, such as the huckleberry patches along the sides of ridges, they seek other cover during the day. As food and cover change with the season, there is a corresponding change in daily activity.

Seasonal habits.—A few general observations can be made at this time based primarily upon the reports of the game wardens and the natives.

The wild hog is active throughout the year and is well adapted to cold weather. Dens are not used even during the winter time. Winter beds are more elaborate and usually located in dense thickets of laurel in some relatively rough and remote area. The wild hog feeds chiefly along mast-producing ridges during the winter season and shifts its feeding area with the changing supply of food throughout the year. No distinct breeding season is known for the species on this forest, a condition that is at variance with that of the same species in Germany (see breeding habits). Adult boars have a much larger daily and yearly cruising radius than any other species on the forest.

Feeding habits.—In general the feeding habits of the wild boars are similar to those of domestic swine. They are omnivorous, feeding upon practically all kinds of plant and animal matter. They often band together and do most of their feeding at night under cover of darkness. However, there is a difference in their manner while feeding. Natives who have observed the wild boars have emphasized the nervous and alert, yet quiet, manner of feeding.

Since the wild boar ranges more extensively than its domestic relative, there is a decided difference in the feeding sign or trail left by the two types of animals. The trail of the wild boar is scattered and extends over a wide area. When an individual feeds alone it frequently roots in a fairly straight line, takes a few steps and repeats the operation, thus producing a fairly straight, scattered trail. It is not unusual for such a trail to extend for several miles, the entire distance having been traveled during a single night. In contrast to this the domestic pig makes longer stops, roots deeper and works over much wider strips. Its feeding sign is therefore much more localized.

Other conditions being equal, the wild boar feeds upon whatever food is most plentiful and easily secured. This results in a drift from one area to another as already mentioned.

Wallowing habits.—Wallows furnished considerable information, since they were used repeatedly by the hogs. The age of the sign was quite easily told, the tracks surrounding a wallow showed the sizes represented in the group using it, and the condition of the wallow or group of wallows gave an idea of the number of wild boars in the group. If a wallow had been used considerably the surrounding vegetation usually was heavily trampled and smeared with mud. Wallows were found chiefly near the upper ends of the higher coves, in shaded, cool and wet places. Some were quite extensive and evidently were used by several animals at a time, while others were just large enough for one individual. These frequently gave a very good idea of the size and shape of the user.

The wallowing habit is continued throughout the year, according to the accounts of local hunters. They report many instances where hogs have broken the ice to wallow and state that, when pursued during the winter, they frequently wallow in each stream that they cross.

Rubbing habits.—Rubbing is a habit closely associated with wallowing. The wild boar usually chooses a pitch pine less than 6 inches in diameter for a rubbing tree. Rubbing was noticed on several other kinds of trees, but such examples were so rare that the preference for pine was clearly shown. Such trees were usually muddied from near the ground (4 to 8 inches) to a height about equalling that of the animal making the sign. On many occasions this muddied and rubbed condition reached a height of 36 inches, and in the area near Pawpaw Cove it reached a heighth of 37 inches. The height of the sign indicates only the approximate height of the tallest animal using the tree. The freshness of the sign indicates its latest use and the color of the mud is indicative of the place used for wallowing. Many bristles were found on and around the trees, which indicated the color of the boars using them. All of these bits of information are useful in determining such things as home range, daily habits, and wandering tendencies.

Figures 3 and 5 show examples of typical rubbing trees. The ground around these trees had many bristles trampled into it. Several trees ranging from 1 to 8 inches in diameter had been killed by repeated rubbing and tusking. An example is shown in figure 5. In Germany such rubbing trees are called boundary trees and are useful to the hunter in determining the presence of wild boars in the area.

The rubbing trees were located along trails and near wallowing places. Several were seen along ridges at a considerable distance from wallows. Not infrequently other trees and vegetation along trails were found muddied. The extent of such sign is an indication of the number of animals and the degree of use. Such sign indicates the height of the larger animals and may also indicate the time of day the trail is used.

Tusking habits.—The wild boar does more tusking than the domestic boar. Tusking sign is very common in inhabited areas. The trees tusked are usually rubbed as well. Figure 2 shows tusking sign. The old diagonal

cuts along the scar in the figure are tusk marks and the places where scar tissue has formed mark older tusk wounds. Tusk injuries have been found only on pine trees and considerable pitch is rubbed from these trees by the wild boar. The pitch may have something to do with the selection of this species. Many wounds are usually present on the same tree, as shown in the figure. On several occasions when the tusk wounds were fresh, tracks could be seen at 12 to 24 inches from the base of the trees, where the hoofs scarred the ground sideways as though the animals had been playing.

Bedding habits.—Several bedding places were observed. With the exception of one, which was located in a rhododendron thicket in Henderson Cove, all were located on the side or near the top of a ridge. Most of the beds were situated in thickets of some kind, and always under good cover. In practically every case the earth had been loosened over the entire bed. No additional materials had been added. Apparently the animals prefer to lie on the bare loosened dirt.

It is to be expected that more elaborate beds will be made during the colder season. Some natives report the boars as cutting considerable brush and throwing it into a pile under which they bed. Others deny this habit in the wild species, saying it is done only by domestic swine. Further field observations are necessary to determine such points.

Breeding habits.—Large wild boars range over a very large area and are known to visit practically all the tame sows present. They drive off or kill tame boars and breed freely with the domestic sows. Judging from the heavily scarred condition of the hides examined and from reports of the natives of badly cut-up tame boars, it seems evident that the strongest, most able boars sire the most pigs.

No distinct breeding season is known for the species on this forest. According to reports from natives, tracks of very young pigs are seen at all seasons of the year. Young pigs too small to leave the bed, which would mean less than one week old, have been seen in December. Observations made during the summer would indicate two breeding seasons, one in December or January, and another in April or May. Both conditions would be at variance with conditions reported for the same species in Germany. Wilhelm Kiessling (loc. cit., p. 34), said that the normal breeding season falls in December. Eberhard von Riesenthal (loc. cit., p. 174) said that the rutting period is rather irregular and takes place from the end of November until the middle of January.

The number of litters per year is also unknown. The small amount of information secured during the summer would indicate about two litters per year for the hybrid animals. In all probability the wild stock has but one litter per year as in Germany.

The gestation period is unknown for this area. In Germany, however, it is given as 18 to 20 weeks (Riesenthal, loc. cit., p. 174). The gestation period for the domestic pig is about 118 days, which, therefore, is somewhat the shorter. Information of this kind may be secured from animals kept in captivity.

Birth of young.—Very little is known about the habits of the wild sows at the time that the young are born. Litters of very young pigs have been found in beds located on the sides of ridges. Signs observed during this study indicate that the sows leave the other hogs at this time. Evidently the young are born in a quiet, secluded spot and are cared for by the sow apart from the other hogs until the young are able to travel with the group. In this respect von Riesenthal says that the sows bear their young in a soft, well concealed bed and the young do not leave the bed for the first few days. After that they follow their mother everywhere.

Growth and development.—When born, the pigs of the wild boar are striped longitudinally with light rusty or sandy colored stripes on a dark brown ground color. The striping gradually disappears at the age of about 6 months. The heads are long and the snouts very pointed from the time of birth. By the time the pigs reach the age of one or two months, they have a very pronounced mane along the spine from the top of the head to the point of the hips. The tail gradually becomes longer than in domestic swine and is pronouncedly so at the age of one year. Local people who have raised young wild boars that were caught in the forest, and who have raised litters from their domestic sows that were sired by wild boars, report a more rapid increase in stature for such pigs than for the full-blooded domestic stock. The weight increase is reported to be less rapid than in the domestic swine after the first few weeks. This can be attributed to the much more rangy characters of the wild stock. They declare it is impossible to fatten the wild stock as they can the domestic animals.

Some interesting information relative to the growth and development of the European wild boar in Germany (which is the same species) is given by von Riesenthal (loc. cit.) as follows: Pigs up to one year of age, 15 to 38 kilograms, or 33 to 84 pounds; shoats up to one year of age, 22 to 72 kilograms, or 48 to 158 pounds. He also says that the dentition offers a check on the approximate age of the pigs; the newly born pig has only 8 milk teeth, therefore not the full dentition. The milk dentition is first complete in 3 to 4 months. At that time the first teeth of the permanent dentition appear. At the age of from 10 to 11 months the permanent dentition is acquired and at the end of two years the wild boar has the entire permanent dentition. If an individual still has the milk canines it is at most 11 months old. After a year the permanent tusks, with their three-cornered cross section, are beginning to grow. The wild boar reaches sexual maturity at an age of one

and one-half years. The last observation indicates that the wild species requires a much greater time to reach sexual maturity than does the domestic hog.

Ecologic relationship to other animals.—Since the wild boar eats practically anything that any other mammal will eat, it is frequently a competitor for certain foods, or, it may actually feed upon the animals themselves.

As far as is known, all of the lesser animals such as the invertebrates, and even the lesser vertebrates, contribute to the boars' diet. Worms, insects and other invertebrates are eaten whenever the opportunity offers, whether they are in, on, or above the ground. Crayfish, frogs, salamanders, lizards and snakes all are taken as food. Even smaller animals, such as chipmunks, young birds, birds' eggs, and the like, are eaten on occasion.

The relation of the boars to the larger game and predatory animals is of direct importance to the wildlife manager. Some of these relationships may be listed by group or species.

Bob-white quail.—Wild boars may destroy an occasional clutch of eggs and possibly catch an occasional young bird of this species. The total amount of such damage is probably very small since the opportunity of such incidents is very limited.

Ruffed grouse.—It has been said by local residents that boars destroy grouse nests and young. No doubt this happens occasionally. On the whole the activities of the boars on this area appear to be more beneficial than harmful to grouse because of the manner in which they turn up the ground, exposing insects, small tubers and similar grouse food. Grouse are plentiful in the area around Hooper Bald and Haw Knob where the wild boars have been present for the greatest length of time. This fact speaks for itself.

Turkeys.—At present turkeys are most numerous in areas inhabited by wild boars. This proves that the two species are not incompatible, in spite of such reports from native hunters. Judging from observations made in the field, the feeding habits of the wild boar are definitely favorable to the turkey. Turkeys frequently work over areas torn up by wild boars to secure the tubers, insects and other food exposed. It is also true that the wild boar consumes large quantities of mast, which is valuable food for turkeys. This competition might be very serious if boars took all of the food from the patches in which they root and wallow. Many tuberous roots, insects and other valuable turkey foods are left by the boars for the keener-eyed bird population.

Generally speaking, it appears that the boars compete with the gallinaceous game birds for certain foods such as berries and mast in season, but, due to the loose feeding habits of the boars, their activities prove beneficial to the birds when other foods become scarce. No doubt some young birds, eggs and nests are destroyed by boars. The fact that the above birds are

most plentiful in the areas populated by boars is good evidence that their relations are satisfactory.

Squirrels and chipmunks.—Chipmunks probably suffer the most from boars, since their winter stores and homes are frequently destroyed and the animals themselves occasionally eaten. The red, grey and fox squirrels do not suffer much, as their arboreal habits protect them.

Skunks.—Since both the little spotted and the big striped skunk are chiefly insectivorous, there should be no serious feeding conflicts, and no evidence was secured to indicate any other unfavorable relations.

Opossum.—The opossum is an omnivorous feeder, although more carnivorous than the boars. Food competition no doubt exists between these species. Few signs of the opossum were seen, probably because of the predators on the area. Probably the boar is not an important factor in the life of the opossum.

Raccoon.—The raccoon is another omnivorous animal with partially aquatic feeding habits. Without doubt the competition between the boar and the raccoon is quite severe in some of the upper coves. Crayfish, frogs, and salamanders are evidently prized by both species, and the boar dominates the situation. There is still plenty of such food in the streams examined, however, and the present scarcity of the raccoon is probably due to hunting and not to boars.

Foxes.—Neither the red nor the grey fox is affected to any extent by the boars. Either fox might catch a very young pig on occasion. These animals probably have very little influence on one another.

Bobcats.—The bobcat is exclusively a predator and in that rôle takes toll of the young pigs. The bobcat is, without doubt, one of the boar's worst enemies. Damage is probably limited to the young pigs and shoats, however, since cats would hardly be capable of killing a full grown animal. If the bobcat became numerous it might well become the limiting factor to the boar population.

Bears.—The black bear is omnivorous and feeds upon much the same foods as the wild boar. Its feeding habits are different, as it depends upon its claws and teeth to secure its food, while the hog uses its nose as a plow. The bear preys upon the boars, killing both large and small animals. The two species do not occupy the same area at the same time, and this fact may become a real problem in managing the area for both species. At the present time there seems to be food sufficient for both species. The bear hibernates during the winter, thus eliminating the food competition at the time of year when food is least plentiful.

Deer.—Deer are herbivorous animals and browse during most of the year; therefore, they would compete with the boars only for the mast crop during the fall and winter. At the present time there is plenty of food in the form of browse for the deer, and a good stand of mast-producing trees. Neither

animal should suffer from this common use of such food until the amount available is more completely utilized. A study should be made of this food relationship during the winter. The same areas are inhabited by both species at the present and they are probably compatible.

Conclusions.—The wild hog on the forest is the European wild boar, *Sus scrofa*. There are a good many animals that appear to be full-blooded wild stock on the forest. Many of the hybrids (wild x domestic) possess many of the physical characters of the wild boar. As far as known, the characteristics of the wild boar are dominant over those of the domestic pig. The hybrids appear to be fertile when crossed in various ways. Wild boars are the most gamey species on the forest. The area is well suited for the species. At the present time there is no severe conflict between the wild boar and the other game species.

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DISCOVERY, HABITAT AND DISTRIBUTION OF THE BLACK-TAILED PRAIRIE-DOG IN WESTERN CANADA

By J. Dewey Soper

For many years after the settlement of the plains, the possibility of the occurrence of the black-tailed prairie-dog *Cynomys ludovicianus ludovicianus* in western Canada remained unsettled. From time to time reports of several isolated colonies in the semiarid region of the Missouri Coteau north of the International Boundary reached various individual naturalists and museums. While these sporadic rumors served the purpose of whetting interest and raising suspicions as to their authenticity, considerable time was to pass before they were finally confirmed. Meanwhile the possible existence of the species in Canada belonged in the same category with the debated occurrence of such other Upper Sonoran Zone species as the pallid vole (*Lagurus pallidus*), Wyoming kangaroo rat (*Dipodomys ordii luteolus*) and black-footed ferret (*Mustela nigripes*).

This state of affairs continued and legitimate doubt was entertained for several reasons. Information was not traced to a source of well-founded reliability; no naturalist had worked the region to provide an exact knowledge of conditions, and there were no published statements or specimens. Besides, the Upper Sonoran Zone was not recognized as extending as far north as the Canadian border and, in consequence, it was fair to assume that animals of this zone would likewise fail to reach this latitude. Moreover, extensive zoological investigations, conducted in the tier of states immediately to the

The information contained in the forepart of this paper is published with the kind permission of the National Museum of Canada, Ottawa.

south, revealed no definite approach of the prairie-dog to the International Boundary. This is shown by referring to its range as stated by Hollister (1916), Miller (1924), Bailey (1926) and Anthony (1928). Seton (1928) proved an exception, but his work on *Cynomys* was published the year following the expedition of the National Museum of Canada to the region involved. In this he mentioned that L. B. Potter, Eastend, had informed him that prairie-dogs occurred near Val Marie, Saskatchewan. His distribution map shows the species as barely entering Canada in a small triangle at the meeting point of the line between Saskatchewan, Alberta, and the International Boundary. There is here a peculiar discrepancy, however, as Val Marie lies 101 miles to the east.

In the light of existing rumors, it was thought highly desirable that the prairie-dog question should receive attention. During the spring of 1937, the National Museum of Canada determined not only to investigate this point, but to launch a general survey of the mammals in a belt of country along the International Boundary from the foothills of the Rockies in Alberta to the Turtle Mountains in Manitoba. The writer was entrusted with this work and established his first Great Plains camp on June 24, 1927, at Milk River, in longitude 112° 25′ west, about 6 miles north of Montana.

Search for prairie-dogs began immediately. Wide areas were investigated on foot, with saddle horse and motor car. Of fundamental importance enroute, and at each succeeding camp to the east, was the interviewing of old-time ranchers, who would unquestionally know of the local presence of prairie-dogs if any existed. In all the work done in southern Alberta no trace of the species was found. At the earlier Saskatchewan camps, after more than 2 months investigation, the result was the same. Eventually an old resident at Climax referred us to Mr. Case Prescott, a rancher of long experience in the Val Marie district. It was said that he was the most likely one to know of presence of prairie-dogs in Canada.

The Prescott ranch headquarters was in the valley of the Frenchman River about 6 miles northwest of Val Marie. Here is was learned at once that a dog town had come into existence, 5 years previously, one mile farther upstream. With the help of proverbial western hospitality, camp was immediately made in this vicinity, from which investigations were carried out between August 27 and September 7. The quest for the prairie-dog in Canada was thus at last successfully and happily terminated, and constituted one of the high lights of the expedition. Some at least of the fugitive reports of earlier years were now proved to have had a foundation in fact.

An examination of the colony demonstrated that it was a small one; but it was sufficiently large to serve all essential purposes. Only 26 burrows were in evidence. The general impression was that approximately the same number, or fewer animals, were present, which if true would mean that many of the dens were in disuse. The situation was a little confusing as all the retreats

appeared to be in service, while the animals were superficially scarce; at the same time the "town" harbored Richardson ground squirrels (*Citellus richardsonii*), perfectly at home in and among the burrows of their big cousins. The entire area over which the burrows were distributed did not exceed about one acre in extent.

The colony was spread on the relatively flat floor of the Frenchman Valley about one-third of a mile northeast of the river. The approximate elevation is 2612 feet above sea level. The valley is about one mile wide with the bottomlands rising gently to the west. Nowhere in the vicinity does it appear to be more than 125 to 150 feet deep, in marked contrast to the condition prevailing at Eastend, where the slopes and benches rise to a height of 500 or 600 feet.

On the hot, bright morning following the discovery of the colony, the prairie-dogs were out in full force. Specimens were, of course, a prime essential, so this phase of the work received first attention. Aware of the close relationship between *Cynomys* and the trio of ground squirrel species with which he had long been familiar, the writer innocently expected quickly to bag all the material desired. Alas, however, for preconceptions, for after several sultry, vigilant hours, only one had been secured. Day after day passed with poor success, but eventually a small number were taken in good condition. A few others were destroyed in the traps by hawks, while several, although fatally shot, instantly escaped down the vertical plunge-holes.

The small series preserved, however, served the basic requirement of establishing an unimpeachable Canadian record. These specimens are of particular interest not only as the first examples for the Dominion, but also because they came from a colony that was then the northernmost outpost of the species in North America. The latitude of this spot is 49°19′ north.

Dr. R. M. Anderson (1929, pp. 21–22) in commenting on the writer's work and material, said that he made "... a special effort to investigate reported occurrences of the black-tailed prairie-dog (*Cynomys ludovicianus*) in the region around Eastend and Val Marie, and was successful in obtaining five specimens of this species, with material for a habitat group for the museum. As far as we know, these are the first authentic specimens taken and recorded in Canada, although there have been various fugitive reports of local colonies".

Details of the Val Marie specimens are as follows: no. 8255, ♀, 390,80,65 mm., weight 2.5 lbs.; no. 8276, ♀, 390,90,60, 2 lbs.; no. 8277, ♀, 350,90,64, 1.5 lbs.; no. 8278, ♀, 390,75,65, 2.25 lbs.; no. 8284, ♂, 400,82,63, 3 lbs. Their general characters apparently deviate in no way from those average for the race.

Shortly before we left the biological camp at the Prescott ranch, in 1927, another prairie-dog town was reported to us as existing at "Prairie-dog Buttes" in the Frenchman River Valley about 6 miles southeast of Val

Marie. It was said to be much larger than the one already discussed, reputedly covering an area of between 5 and 10 acres. Less definite information indicated another town in the same valley, between Breed and Otter creeks, some 13 or 14 miles still farther to the southeast and 4 or 5 miles north of the United States. As the essential object of the expedition had already been accomplished, and as time was pressing, no effort was then made to substantiate these reports. They were, however, not forgotten and as the years went by it was hoped that opportunity would some day offer to explore the lower reaches of the Frenchman Valley above the 49th parallel.

Following these investigations, additional data came to the National Museum of Canada over a period of several years. For these records I am indebted to Dr. R. M. Anderson, who kindly furnished them from the Museum's files during the preparation of this paper.

In 1929, Mr. F. Bradshaw, Director of the Saskatchewan Provincial Museum, wrote to Dr. Anderson saying that he had visited a prairie-dog town in section 25, township 2, range 13, west of the 3rd meridian, where he estimated that about 500 mounds and 1000 animals were present. This undoubtedly has reference to the "Prairie-dog Buttes" colony earlier mentioned.

Subsequently, Mr. Bradshaw sent out a number of circulars as to the occurrence of this species in Saskatchewan. The results of this enquiry were sent to Dr. Anderson in a letter dated February 19, 1930. Briefly, J. E. Gunn, of Coriander, saw near that place a prairie-dog that had been killed by a dog; this was quite likely a straggler from the "Prairie-dog Buttes" town only 10.5 miles southwest. L. B. Potter, Eastend, stated that W. Wiley, section foreman at Knollys, informed him that there was a small prairie-dog town a few miles south of Supreme, on the Consul-Val Marie railway. This is in township 2, range 26, west of the 3rd meridian. In all probability it was located in the Battle Creek Valley, which is tributary to Milk River and about 9 miles north of Montana. Mr. Bradshaw stated that the remainder of the reports, which covered the 4 southern townships between the Manitoba and Alberta boundaries, lacked information of any value, which indicated that, aside from the Val Marie colony, the species had made very little headway in Saskatchewan.

In 1931, Charles Holmes, Dollard, Saskatchewan, sent notes to Dr. Anderson regarding a prairie-dog town that he visited in township 1, range 2, west of the third meridian. He said: "In this locality there are several prairie-dog towns, one extending over some 600 acres. I secured several specimens of them, all of which weighed 2 pounds each and were the black-tip variety". It would appear that this colony is identical with the one earlier reported on the Frenchman between Breed and Otter creeks.

During the last week of July, 1934, Charles J. Guiguet, formerly of Shaunavon, caught a male prairie-dog 12 miles southeast of Cadillac in section 14, township 7, range 13, west of the third meridian. It was sent to the National

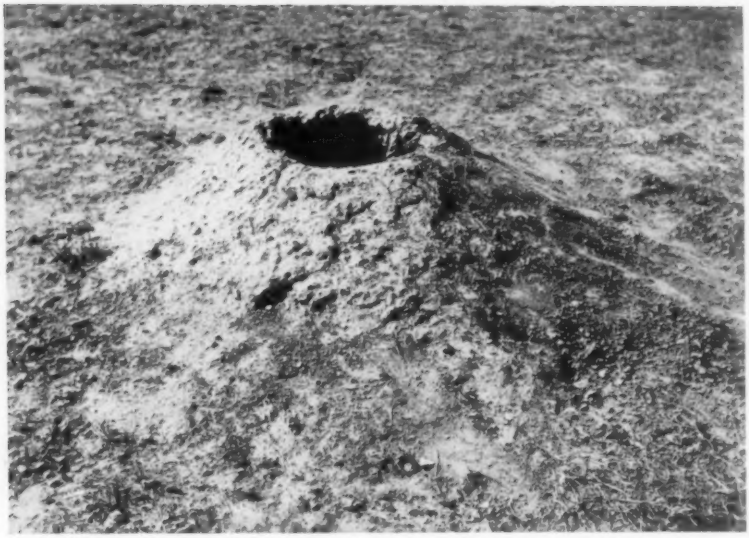

FIG. 1

FIG. 2

FIG. 1. Prairie-dog mound, Frenchman River Valley, northwest of Val Marie, Saskatchewan, August, 1927. FIG. 2. View of Prairie-dog town northwest of Val Marie. Bottomlands of the Frenchman River Valley looking west, August, 1927.

Museum of Canada (now no. 12681). The locality is about 27 miles due north of the "Prairie-dog Buttes" colony, and roughly 18 miles still farther north than the Coriander record; like the latter, it was probably a stray from the colony just mentioned.

Opportunity to study the species southeast of Val Marie came, in part, to the writer during the summer of 1937. In company with Mr. Fred Dunk, Director of the Provincial Museum of Saskatchewan, an ornithological inspection was made of the Val Marie reservoir, a project that had been completed the previous fall under the Prairie Farm Rehabilitation Act. Incidentally, and of much interest to the writer, it was found that the reservoir completely covered with several feet of water the area where the National Museum camp and the prairie-dog town was located in 1927. The prairie-dogs were gone. The writer's old friend, Mr. Prescott, who was again visited, remarked that none now existed in the valley anywhere to the northwest of Val Marie.

Work here having been completed, we determined, before leaving the district, to investigate the nearer of the dog towns reported to the southeast. Accordingly, on the afternoon of July 6, circuitous trails were followed over a wild territory and the prescribed location finally reached on the Frenchman River. No sooner had the gently undulating bottomlands been entered than prairie-dogs were observed in all directions.

This was approximately 7.5 miles in an airline southeast of Val Marie, township 2, range 13, west of the third meridian. It will be observed that this is in very close agreement with the 1927 reports, described as 6 miles southeast of Val Marie, at "Prairie-dog Buttes". Subsequent investigations proved this approximately accurate for the western limits of the colony, it having been entered not from the northwest but from the southeast.

The locality is substantially similar in character to the country about Val Marie. Topographically the chief difference lies in the greater breadth and depth of the valley and the bolder outlines displayed in fantastically weathered buttes and deeply eroded tributary coulees. At this point the terrain has definitely developed into a badlands type that becomes increasingly more rugged to the eastward. The valley floor is gently rolling, deeply trenched in places by freshet streams, and rises gradually to the benchlands and buttes that introduce the steep acclivities mounting for 200 or 300 feet to the high, surrounding plains.

There are no trees, and shrubbery of notable size is rare. Everywhere sagebrush is in evidence and this comprises the most highly characteristic vegetation of the environment. At the best of times the region is semiarid; now, at the end of 8 successive years of acute drought, desert conditions are closely simulated.

The prairie-dog town is confined to the slightly inclined floor of the valley flanking the river. It proved to be much larger than anticipated. Accord-

ing to the 1927 reports it was expected to cover about 10 acres, but it was immediately seen to be much greater. Less than 48 hours were available for studies here, and a multitude of other activities precluded an exhaustive study of the ground and delimitation of the colony. Based on such investigations as were possible, however, we are fairly certain that the occupied area is close to 700 acres. It may, indeed, be much larger. Our observations were restricted to the vicinity of the southeastern part of the big loop on the Frenchman River in the northeastern part of township 2, range 13. We have no knowledge of any extension down stream eastward of the river bend in longitude 107°37′30″ west.

The camp was situated, as near as we could judge, in the northeast quarter of section 25, about one-half mile from the river bed and one-third of a mile from the wall of the valley to the east and south. This was well within the dog town, where in numerical abundance, animals and mounds were fairly representative of the remainder of the visited range. Mounds, in general, were scattered about from 25 to 50 yards apart and in some instances considerably farther. From a rough estimate it would appear that there was an average of no more, at most, than 5 or 6 to the acre, and fewer on the margins of the colony.

Seton (1928, p. 280) remarked that the Biological Survey experts, in a spirit of conservatism, set the prairie-dogs in an ordinary town at 25 to the acre. Although Seton gave figures that would imply as many as 1200 to the acre, even the Biological Survey figure, from our cursory observations, seems appreciably too much for this area. This is to be expected at the northern fringe of distribution, as compared with the centre of the geographic range with its maximum abundance. It is probably close to actuality to take about one-half of the Survey's estimate in this case, which would thus give for the "Prairie-dog Buttes" colony a total of roughly 8700 individuals.

This figure is much larger than Bradshaw's estimate for presumably the same colony. The writer's estimate may be too high, but it is quite certain that the former's is now, at any rate, much too low; it is conceivable that a substantial increase has occurred in the 8 years since Bradshaw's visit. From local report it appears that the animals have been very little molested in the past. A rancher, it was said, in the spring of 1937 broke and sowed to grain a piece of land on the south margin of the dog town and thereupon began a poisoning and gassing campaign to eliminate or reduce the animals in the vicinity. This plot of sowing was visited and was seen to have failed because of drought; if the control measures reported were actually practiced, it was apparently of little avail, as many prairie-dogs were noted in and about the cultivated strip.

Specimens were taken for both the Saskatchewan Provincial Museum and the Winnipeg collection. The animals were extraordinarily shy and retiring and the same difficulties were experienced as in 1927. The two adults in the latter collection measure: No. 3822, ♂, 392,82,62; no. 3836,

♀, 360,72,57 mm. An immature female taken on July 7, no. 3833, measured 273,60,55. This specimen is much paler (less buffy) than the adults, and the hair is finer, softer and smoother to the touch. In comparison with the adults, measurements of the latter give an exaggerated impression of size, as it is certainly no more than one-half grown.

Over the entire area occupied by the colony a highly marked degree of aridity prevailed. Under weeks of cloudless and rainless sky and burning sun the ground was dried, cracked and baked to the hardness of a floor. Aside from sagebrush and such large plants, vegetation had almost disappeared. This poverty of cover was greatly increased in the vicinity of all occupied burrows; indeed, for a distance around of 40 feet or more, the grasses were virtually demolished, leaving the earth sterile and naked. Such utter impoverishment of habitat frequently caused one to wonder how the animals succeeded in existing. This they did, doubtless by wide skirmishing, but during our sojourn in the locality it was unusual to see a prairie-dog more than 25 or 30 yards from its burrow.

Notwithstanding these conditions, the animals seemed content and well-fed. This is truly a marvel of adaptation to aridity, and especially in view of the size of the animals and the bulk of food required. That they were in excellent condition, and therefore not victimized by drought and poverty of food supply, is proved by the fact that all specimens taken were laden with fat. There is an adaptation to lack of water even more wonderful, for it is evident that when rain fails these animals must go weeks or months at a stretch without it. According to our observations dew is rare.

At the time of our visit, juveniles were common throughout the colony, evincing a good season of reproduction. These, from superficial examination with x8 binoculars, appeared to vary from about one-third to one-half adult size. They were seldom observed away from the home mound; when they did venture it was apparently for no more than a few feet. With the virtual barrenness of the vicinity, it was problematical how they obtained sufficient food.

In general deportment the young are as shy and fearful as the adults, rarely permitting a closer approach than 50 to 70 yards. A familiar sight is a parent with a couple of youngsters—less often 3 or 4—closely grouped on the apex of the mound sunning themselves, barking and surveying their surroundings. In this they bear a close physical resemblance, at a distance, to fat, overgrown Richardson ground squirrels. The closer one approaches the more energetic becomes the "yapping" and vertical twitching of tails. Finally they work themselves into a perfect frenzy of excitement. A well determined danger line seems to be universally established, for almost invariably the whole family, in rapid succession, dives frantically into the plunge-hole as one draws within 60 or 70 paces. Exceptionally timorous individuals allow themselves a wider margin of safety.

Despite the exceeding dryness of the weather, with no prospect of rain,

the mounds were kept in excellent repair. The symmetrical fashioning of these singular structures is of extraordinary interest. Evidently there never is slackening of effort at the home den to maintain the evenly tapering cone and crowning crater in the best of accepted contours. The mounds are usually about one foot high and 3 to 4 feet across at the base, but from time to time they may be added to until they are considerably larger. Those in obvious disrepair have undoubtedly been abandoned by the prairie-dogs. Many such, in the Frenchman River colony, were occupied by *Citellus richardsonii*. The instantly distinctive feature of a dog town is these earth mounds conspicuously erected at the mouth of each den. Especially when the sun is low, casting long shadows, they are clearly discernible over a wide area.

On one or two occasions the animals were seen at a distance with the glasses to be scratching up the dry, hot earth about these pyramids and packing it down with noses and feet. A few of the plunge-holes terminated at the apex of the mound at a slight angle, but the greater number penetrated the earth deeply in the perpendicular. It is obvious, from reading available literature on the subject, that the general habits of these northern animals are in no way different from those living farther south.

The ecological and zonal character of the two localities referred to in this paper may properly be discussed as one, as they are essentially similar and only 13 miles apart. A slight difference prevails, in-so-far as northwest of Val Marie various large and almost tree-like willows (*Salix*) thrive to form a narrow zonation along the river in association with snowberry (*Symphoricarpos*), prairie rose (*Rosa*) and buffaloberry (*Lepargyrea*); to the southeast at "Prairie-dog Buttes" the large willow and buffaloberry are absent.

Sagebrush (*Artemisia*) is the universally dominant growth in the valley and on adjoining acclivities, while the greasewood (*Sarcobatus*) is scattered and of more local distribution. The two species of cacti, the prickly-pear (*Opuntia*) and (*Mamillaria*), are fairly prevalent. Other characteristic plants are grama grass (*Bouteloua*), buffalo pea (*Astragalus*), bearberry (*Arctostaphylos*), creeping juniper (*Juniperus*), shiny-leaved buffaloberry (*Shepherdia argentea*), wild sunflower (*Helianthus*), low evening primrose (*Oenothera*) and Indian paintbrush (*Castilleja*).

On the basis of an incomplete local list of birds, mammals and plants, there are many forms typical of both the western semiarid division of the Transition, and the Upper Sonoran zones. In the writer's opinion, held since 1927, there is a distinct, although probably somewhat dilute, intrusion of the latter zone from the south into Canadian territory. For the most part it would appear to be a coalescence of the elements distinguished in these zones and in Canada confined strictly to the southern limits of her Great Plains on the Missouri watershed. The Upper Sonoran is evidently not shown here on any published zonal map of North America; in fact, as laid down for the states of North Dakota and Montana, it falls well short of the Canadian border.

That Dr. Anderson recognized the presence of this condition on the Missouri watershed in Canada is shown by comments in his "Faunas of Canada" (1937, p. 36); the end of his discussion in relation to the campestrian section reads as follows: "... the extreme south of this area ... shows a close approach to Upper Sonoran Zone fauna not heretofore considered to extend much farther north than central Montana. The unusual presence of some of these forms may be due to the prolonged drought conditions in the area during the past few years". To a certain extent this conclusion is unquestionably correct. It should be recalled, however, that many characteristic forms of this zone, which have already been mentioned, were well established in southern Saskatchewan and Alberta long before the beginning of the present intense drought period dating back to about 1929.

While the writer is convinced of the presence of this zone in the region under discussion, he is fully aware of the certainty that it occupies a relatively small area. In fact, from present indications, it would appear to be substantially confined to the chief drainage areas leading to the Missouri River. Thus its typical manifestations in fauna and flora were most definitely observed along Milk River (3100 to 3600 feet), Lodge Creek (3100 to 3400 feet), Frenchman River from "Prairie-dog Buttes" to Eastend (2600 to 3000 feet), and Rocky Creek (2800 feet) south of Wood Mountain. Although the condition is still suggested at Big Muddy Lake (2500 feet), drained by Big Muddy Creek to the Missouri, it is not as pronounced as farther west.

Of all the faunal indicators in this region, none is more conspicuously indicative of the Upper Sonoran than the subject of this paper. It is seen that the distribution of *Cynomys* in Canada, as far as absolutely known, is restricted to the valley of the Frenchman River. (For the time being this ignores the Battle Creek locality report.) Significantly enough, this valley is the largest in Western Canada, with the exception of Milk River, which connects with the Missouri River. West of about the 103rd degree of longitude, Anthony (1928, p. 219) mapped the northern range limit of the species as roughly following the Missouri and Milk rivers; from the point where the latter bends to the northwest near Havre, Montana, the line is carried almost due west to approximately longitude 112 degrees; this is the closest approach to Canada shown, at an average distance of about 30 miles.

The airline distance from the junction of Milk and Frenchman rivers, which lies on the main frontier of northern distribution, to the former prairie-dog town northwest of Val Marie is about 60 miles, or probably near the 100-mile mark following the meanderings of the Frenchman Valley. At present the northernmost outpost of the species is at the "Prairie-dog Buttes" colony 48 miles north-northwest of the river forks alluded to, or close to 80 miles by river, and 11 miles due north of Montana.

It is assumed, because of the considerable numbers present at the latter point, that the species occurs, at least intermittently, throughout the valley southward to Milk River. The reported town of 1927 in the Frenchman

Valley, between Breed and Otter creeks, was not personally verified, but Holmes' investigations in 1931, ostensibly referring to the same, proves the statement to have been reliable. Facts in the case indicate a consistent, narrow line of advance all along the lower Frenchman. It will be interesting to learn eventually the nature of this northward tongue of occupation along the latter stream in the Montana section. Also if there are any other northern tributaries of the Missouri and Milk rivers in this state that have been seized upon by the species for extending its range northward in attenuated lines beyond the principal area of distribution.

Knowing the propensities of the species in the Frenchman Valley, it would in no wise be surprising to learn of its next and most logical invasion of Canada by way of the Upper Milk River Valley into southeastern Alberta. Continued drought, with the consequent northward spread of Upper Sonoran Zone conditions, would not unlikely achieve this result, as it has visibly extended the northward range of various species of birds and mammals since the early settlement of the West.

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REAPPEARANCE OF THE SOUTHERN SEA OTTER ALONG THE CALIFORNIA COAST

By Rolf L. Bolin

About the middle of March, 1938, Mr. and Mrs. H. G. Sharpe, residents of the central Monterey County coast, reported the appearance of "several hundred sea otters" off the mouth of Bixby Creek. Since the southern sea otter, *Enhydra lutris nereis* (Merriam), has been considered as practically extinct, this report was received with elevated eyebrows. A single sea otter or possibly a pair might be conceivable, but their presence in large numbers seemed to be beyond belief. An investigation on March 25, however, revealed a group of about 50 sea otters at the stated locality, 36° 22′ 15″ N. Lat., 121° 54′ 15″ W. Long., and the Sharpes declared that several times that number had previously been present.

The sudden reappearance of the species in considerable numbers is not particularly surprising when the character of the coast is taken into consideration. The region has been comparatively inaccessible and was first opened to through motor traffic during the summer of 1937. Sheer cliffs or very steep slopes rise directly from the sea to a height of several hundred feet, making access to the beach difficult. The shore, studded with massive projecting rocks and almost continuously hammered by a heavy surf, affords no protected anchorage and is usually given a wide berth by coastwise shipping and by the Monterey fishing fleet.

This has been a region where sea otters could live unmolested by man, the single factor responsible for their near-extermination. The present herd has probably been resident in the vicinity for years, the slowly increasing progeny of a very few survivors of the era of intensive unrestricted hunting. They have probably been seen several times during the past two decades but remained unrecognized, since from a distance the sea otters might easily be mistaken by a casual observer for seals or sealions. In fact, their discovery was due to the testing of a newly repaired telescope and the herd may have been at their present location for months before being noticed.

Since their discovery, the sea otters have moved about one-half mile northward along the coast. According to reports this short migration immediately followed an attack upon the herd by a small school of killer whales, *Orcinus rectipinna* (Cope).

The herd varies considerably in size. It is difficult to make an exact count as the individuals are either very close together or moving actively about. Successive counts made a few minutes apart may vary as much as 10 per cent or even slightly more, but counts made on different days and yielding values as small as 24 and as great as 77 can not be attributed to error, and appear to indicate the presence of more than one herd in the vicinity with individuals migrating back and forth between them. Since this paper was

submitted six other herds have been discovered farther south along the coast and the number of known individuals has risen to 150.

Estimating from the size of sea gulls and cormorants, all of the sea otters are between three and four feet in length. Although they have been reported to breed at all seasons of the year, no small individuals were seen. The usual color is a uniform tawny brown but a few individuals have a silvery white head with the light color fading out on the shoulders and low on the chest. This makes these individuals, possibly old ones, very conspicuous.

The typical resting position of the sea otters in the dense herd seems to be on the back, with the head turning from side to side, the short front paws folded on the chest or with the palms together in what can only be called a prayerful attitude. The hind flippers then usually stick straight up and occasionally perform slight balancing motions, while the tail trails behind. Generally the sea otters do not remain very long in this position, for they spend a great deal of time scratching themselves. The front paws massage the head, which is brought forward within reach, the operation looking very much like vigorous washing. The hind flippers scratch the belly or by strong arching of the back are brought into action on the shoulders, nape, or back of the head. Several were observed to use the flippers in scratching the tail, which was brought forward between them. Very frequently the flippers are brought forward to the mouth and apparently searched for parasites, or individuals may even bend far enough to chew at the base of the tail and the rump. Frequently sea otters, standing straight up in the water, shake themselves vigorously like a wet dog. Others, lying horizontally, rotate on a longitudinal axis apparently for the sheer fun of it, performing a complete revolution about once a second and continuing the rotation for half a minute or more. Often two or rarely three individuals play together like puppies, biting each other and rolling over and over for minutes at a time.

Several of the sea otters were observed eating large sea urchins, *Strongylocentrotus franciscanus* (A. Agassiz), and red abalones, *Haliotis rufescens* Swainson. Broken tests and empty shells of these species were found on the beach. A sea otter dives to the bottom and returns with its prey in a surprisingly short time. Then, resting on its back and holding the food in its front paws, it proceeds in leisurely fashion to nibble or gnaw at it. In the case of the sea urchins they often hold the food in one paw, remove the soft parts with the other, transfer these to the mouth and lick their fingers.

The herd is carried slowly along the beach by water currents. After drifting a few hundred yards the sea otters return to their original position. They all start at the same time as though at a signal, swimming liesurely on their backs or bellies or spiralling as they go. The rolling or spiral swimming seems to be a favorite habit except when they desire to attain speed. Then they stay on their bellies. Often at the start of one of these short trips the

entire herd dives as though at a signal, disappearing for about 20 or 30 seconds and breaking the surface again at a considerable distance, in an elongated but compact swimming group.

Usually a few sea otters are scattered out in all directions at some distance from the main herd, possibly acting as sentinels. Two such individuals displayed considerable interest in me when I appeared on the beach. They approached to within about 60 yards and stood upright in the water, eyeing me, with only their heads above the surface. I judged that while they stood perfectly quiet in this position only about one-sixth or less of the body was exposed, while in resting individuals of the main herd, buoyancy appeared to support at least a fourth of the body above water. Periodically the sentinels sank straight down and a few seconds later appeared several yards to the right or left. After being inspected for 10 minutes I walked along the beach and was escorted for about 100 yards by the two individuals, who then apparently decided that I was not dangerous and returned to the main herd.

The reappearance of this interesting and extremely valuable mammal in considerable numbers has excited much local comment. It is to be hoped that the herd can be protected from hunters and allowed to increase to the extent that it will cease to be a mere zoological curiosity and become a valuable natural resource, subject to limited exploitation under strict regulation. The State of California Division of Fish and Game has been prompt in assigning a warden to guard the sea otters, and their increase appears to be assured.

Hopkins Marine Station, Pacific Grove, California.

THE VISCERAL ANATOMY OF THE KANGAROO RAT

By Edward E. Midgley

The kangaroo rat (*Dipodomys*) is a mammal of particular interest. An investigation of its visceral anatomy was undertaken by the writer with the purpose of describing in detail the internal anatomy of this genus and of making comparisons with other rodents. In the drawings presented the organs are shown both *in situ* and removed from the body. The size and weight of the various organs are of little importance in a topographical study. The data presented are intended to give an idea of the comparative size and weight of each organ with respect to other organs of the same specimen.

For purposes of orientation and comparison, considerable use was made of Greene's "Anatomy of the Rat" (1935), which is a study of the albino rat. "The thoracic and abdominal viscera of primates" (Straus, 1936) was used as a model for the investigation.

This work was carried on under the guidance of Dr. W. W. Newby and Professor Stephen D. Durrant, both of the University of Utah, and to them I am deeply indebted. Appreciation is acknowledged to Dr. R. V. Chamberlin, head of the Biology Department at the University of Utah, for supplying facilities necessary in completing this work.

Materials and methods.—Several specimens of *D. microps levipes* were obtained for me by Dr. Newby and Professor Durrant at Pine Valley, 50 miles west of Milford, Millard County, Utah, at 5000 feet altitude. These were preserved in formaldehyde. A second lot of specimens, of *D. ordii columbianus*, was trapped by me on the sand dunes west of Salt Lake City, 1 mile east of Great Salt Lake, at 4200 feet altitude. They were placed immediately in the embalming fluid suggested by Hyman (1922).

The drawings and descriptions presented are representative of the majority of the specimens. The slight variations observed were probably due to differences in methods of preservation and not to species differences. It is beyond the scope of this investigation to determine the variations in the visceral anatomy of the two species. The conditions herein stated are considered as general for the genus *Dipodomys*.

External morphology.—There is a combination of external characteristics which sets the kangaroo rat apart from all other rodents: The hind legs are over three times as long as the weaker front legs; the "paintbrush" tail is longer than the body; the external cheek pouches are characteristic only of this family (*Heteromyidae*) and the pocket gophers (*Geomyidae*); the head is broad, flattened and triangular, carrying large, protruding eyes and ears of moderate size.

The external measurements of an adult *D. microps levipes* of average size were: Total length, 235 mm.; tail vertebrae, 133; hind foot, 39; fore foot, from wrist to longest claw, 13; and ear, from notch to tip, 14. Its weight

(before fixation) was 119 grams. The external measurements of an adult male *D. ordii columbianus* of average size were: Total length, 243 mm.; tail vertebrae, 137; hind foot, 40; fore foot, 13.5; and ear, 14. Its weight was 124 grams.

DIGESTIVE TRACT

The organs of the abdominal cavity in the kangaroo rat show marked variations from those of other rodents studied. These variations are probably due to the relative shortening of the body, in turn correlated with the long hind legs.

The esophagus is a straight tube dorsal to the trachea. It causes an indentation in the liver just caudal to the quadrate lobe, and enters the stomach at the cardia slightly above the greater angle of the lesser curvature.

The stomach is a well rounded, U-shaped structure, separable into distinct cardiac, fundic and pyloric divisions (figs. 2, 3). It lies in a transverse plane closely pressed against and partly covered by the left lateral lobe of the liver. The spleen is closely associated with the stomach, lying across the posterior surface of the fundus. The beginning of the duodenum is easily identified from the well-marked pylorus. A well defined glandular area in the fundus can be seen. Externally the stomach exhibits no constrictions. Internally, gastric ridges or rugae occur around the cardia and over the fundus. The pyloric portion is not ridged. The weight of the stomach when full was 12 grams. It measured 17.2 x 14.3 x 7.1 mm.

The stomach is supported by mesenteries that resemble those of the rabbit, as described by Hyman (1922). The greater omentum is short, extending from the greater curvature of the stomach to the transverse colon, with which it is fused, and enclosing the spleen in its wall, this part forming the gastrosplenic (gastrolienal) ligament. From the lesser curvature the lesser omentum passes to the liver (gastrohepatic ligament). There is no infracardiac bursa directly connected with the omental bursa of the abdominal cavity. The latter bursa lies caudad to the transverse colon and the stomach, just caudad and dextrad to the caudate lobe of the liver. The foramen of Winslow is bounded on its ventral side by the lesser omentum and the pylorus of the stomach. The caudate lobe of the liver projects within this foramen.

The small intestine.—"This portion of the alimentary tract is divisible into two parts—the duodenum and Meckel's tract (Mitchell, 1905)—not into three" (Howell, 1926).

The duodenum has four portions; from the pylorus the duodenum follows the posterior border of the liver for 11 mm., then curves caudad as the descending limb for 15 mm., turns to the left as the transverse limb for 14 mm., finally turning anteriorly as the ascending limb for 12 mm. (fig. 4). The first portion is retroperitoneal. The remainder is bound to the liver by the hepatoduodenal ligament, is supported by part of the dorsal mesentery, the

mesoduodenum, and is attached to the right kidney by the duodenorenal ligament.

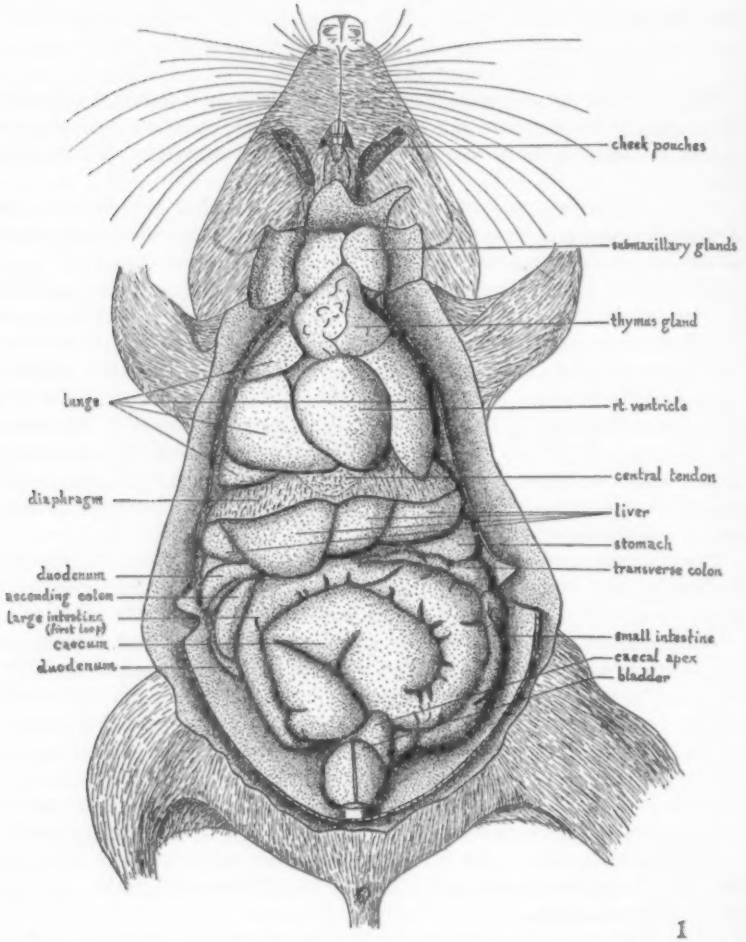
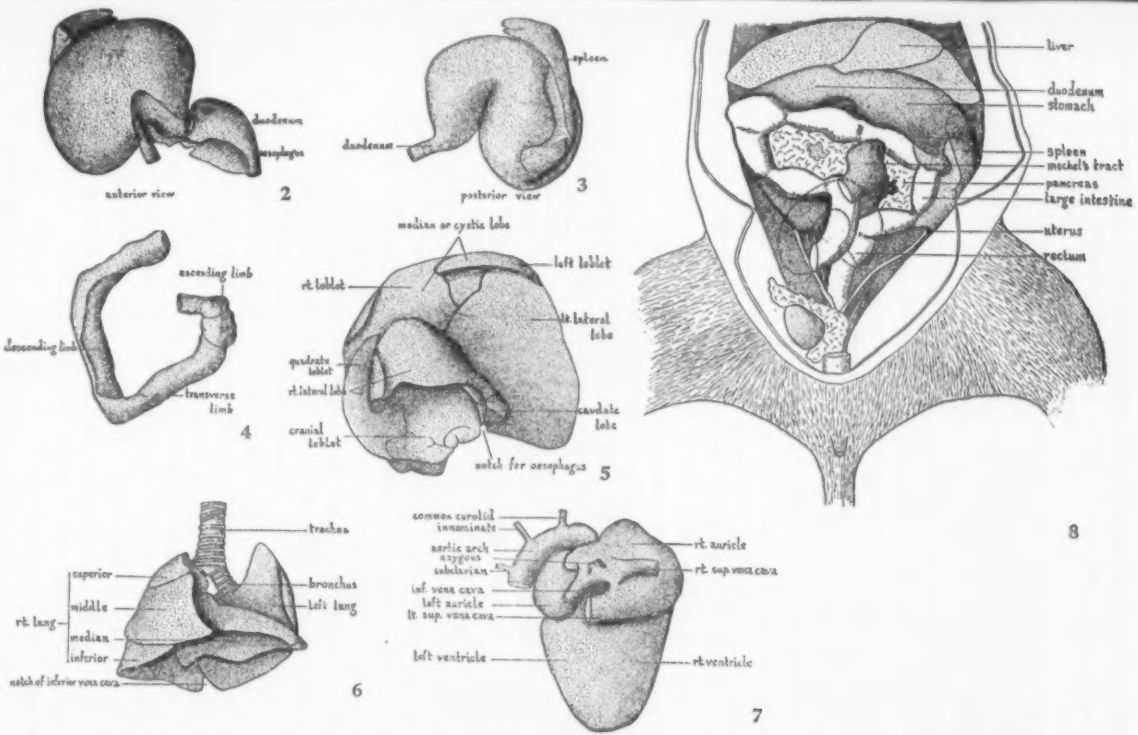


FIG. 1. The thoracic and abdominal viscera of the kangaroo rat in situ. The first loop of the large intestine about the cecum is shown.

Meckel's tract is approximately twice as long as the large intestine. This is unusual in rodents and may indicate a great degree of specialization of



FIGS. 2–8. 2. Anterior view of the stomach. The ventral surface is at the top. 3. Posterior view of the stomach. 4. The duodenum. 5. The lobes of the liver. 6. The lungs and trachea. 7. Dorsal view of the heart. 8. The large intestine, representing the second loop (dotted) and the third loop. The liver has been cut, the better to expose the stomach and the complete tract.

the glands and mucous lining of this region (figs. 9–12). It measured 230 mm. in length, with a collapsed width of 3 mm. It weighed 1.7 grams.

The cecum.—At the junction of Meckel's tract with the large intestine there is an enlargement, the sacculus rotundus. From the latter extends a large blind sac, occupying over half of the ventral portion of the abdominal cavity. The first part of this is the cecum, extending for 21 mm. (fig. 1). The last part forms the appendix, extending for 9 mm. The constriction separating the appendix and the cecum is only slight and lies directly ventral to the rectum. The total weight of the cecum and appendix was 1.5 grams.

The cecum is closely united by mesenteries—part of the dorsal mesentery—to the first coil of the large intestine. This first coil is not attached to the other coils of the intestine on its ventral side by mesentery. The small intestine enters the cecum near the center of its dorsal surface.

The large intestine, or colon, begins its course at the left side of the cecum and is supported by part of the dorsal mesentery, the mesocolon (figs. 1, 8). The colon makes two complete loops before becoming the ascending part of the colon. The first loop circles the cecum proper. The second loop is directly dorsal to the first and leads into the ascending colon, which, in turn, lies in close proximity to the descending limb of the duodenum. The large intestine then crosses the peritoneal cavity from right to left, close to the stomach, as the transverse colon, then turns abruptly caudad as the descending colon. At this turn the mesocolon is fused to the stomach. The large intestine measured 120 mm. in length, with a weight of 1.1 grams.

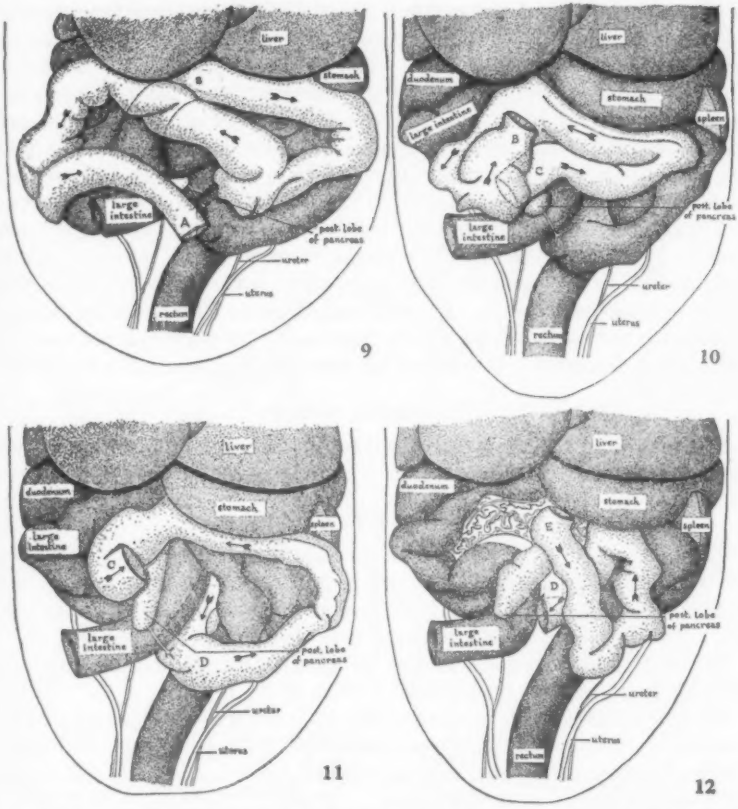
The teniae coli—tenia libera, t. omentalis, and t. mesocolica—are prominent in the first part of the large intestine and the cecum. The contraction of the teniae produce a row of distinct sacculations, the haustra coli.

The ascending and transverse colons are intraperitoneal. The descending colon is retroperitoneal and passes posteriorly, disappearing dorsal to the urogenital organs as the rectum.

The liver of the kangaroo rat is divisible into 4 distinct lobes; the median or cystic lobe, the right lateral lobe, the left lateral lobe, and the caudate or Spigelian lobe (figs. 1, 5). The cystic lobe is the largest and consists of two—the right (larger) and the left—loblets. The right lateral lobe is also divisible into two loblets—the cranial, which is the larger of the two and contains a deep pocket encircling the major part of the right kidney, and the quadrate, which is situated anteriorly to the cranial loblet, helping to form a part of the pocket. The left lateral lobe is single and larger than the combined loblets of the median lobe. It covers most of the stomach and duodenum. The caudate lobe is quite small and fits partly around the esophagus. The weight of the liver was 2 grams (formalin fixation). It measured 19 x 22 x 14 mm.

The mesentaries of the liver are essentially the same as those found in other rodents. The ventral mesentery surrounds the liver from the junction

of the two median loblets and continues ventrally to form the falciform ligament. The peritoneal covering of the liver continued cranially and



FIGS. 9–12. Serial drawings of Meckel's tract. 9. That portion of Meckel's tract immediately visible after removal of the cecum and first part of the large intestine. *A* marks the last portion of the tract where it enters the cecum. The arrows indicate the path of the food in its normal course through the tract. 10. A representation of the coils underlying the coils shown in 9. *B* marks the cut made to remove the coils shown in 9. 11. Continuation of the tract toward the duodenum. 12. The tract upon removal of the coils shown in 11. *E* marks the junction of the tract and the duodenum.

dorsally into the coronary ligament, attaching the liver to the central tendon of the diaphragm.

The kangaroo rat has no gall bladder. The ductus choledochus is made

up of several tributaries from the lobes of the liver and empties into the first part of the descending limb of the duodenum.

The pancreas lies within the dorsal walls of the omental bursa and consists of disassociated bits of pancreatic tissue of the low dendritic type usual in rodents (figs. 8–12). The head of the pancreas extends dorsad to the beginning of the ductus choledochus. The body is attached to the ascending, transverse, and descending parts of the duodenum. It is much branched and is accompanied by blood vessels. The tail assumes a tubular shape and extends caudad to the sacculus rotundus, following the inferior vena cava on the ventral side. The pancreatic ducts are many and variable. None could be found entering the duodenum in conjunction with the ductus choledochus.

The spleen is located dorsocaudad upon the posterior surface of the fundic part of the stomach (fig. 3). The dorsal one-third of the spleen is bent at a right angle to the remainder and lies in close proximity to the left portion of the body of the pancreas. It is surrounded by the folds of the peritoneum which give rise to the usual splenic ligaments—the phrenicolienal and the gastrolienal ligaments. It weighed 0.5 gram and measured 18 x 3 x 1 mm.

UROGENITAL SYSTEM

The urogenital system of the kangaroo rat corresponds in most respects to that of the white rat (figs. 13, 14).

Male

The kidneys.—The right kidney of the male kangaroo rat lies cephalad to the left and is slightly larger, measuring 11.9 x 5.0 x 5.7 mm. for the right and 10.6 x 6.6 x 5.5 mm. for the left, with an average weight of 0.35 gram (fig. 13). It lies entirely retroperitoneally, with the hilus well marked.

The ureter passes caudally, crosses the ductus deferens dorsally, and enters the dorsal surface of the fundic portion of the bladder.

The urinary bladder is pear-shaped (fig. 1). Along its dorsolateral surface a mesentery, the lateral ligament, is found extending toward the umbilicus. The median ligament, containing the urachus, extends along the midventral line from the bladder to the umbilicus.

The suprarenal glands are well marked, discrete, encapsulated bodies, slightly triangular in shape. In the male they are somewhat smaller than in the female, measuring 3.2 x 2.3 mm. and weighing 0.1 gram.

The testes are situated partially in the abdominal cavity, which seems to be usual in rodents during sexual inactivity. The anterior end of the testis is covered by the caput epididymis, which passes into a more constricted mass of tubules, the corpus epididymis. This, in turn, becomes the cauda epididymis on the posterior surface of the testis, from which the ductus deferens leads back through the inguinal canal and crosses the ureter before joining the urethra.

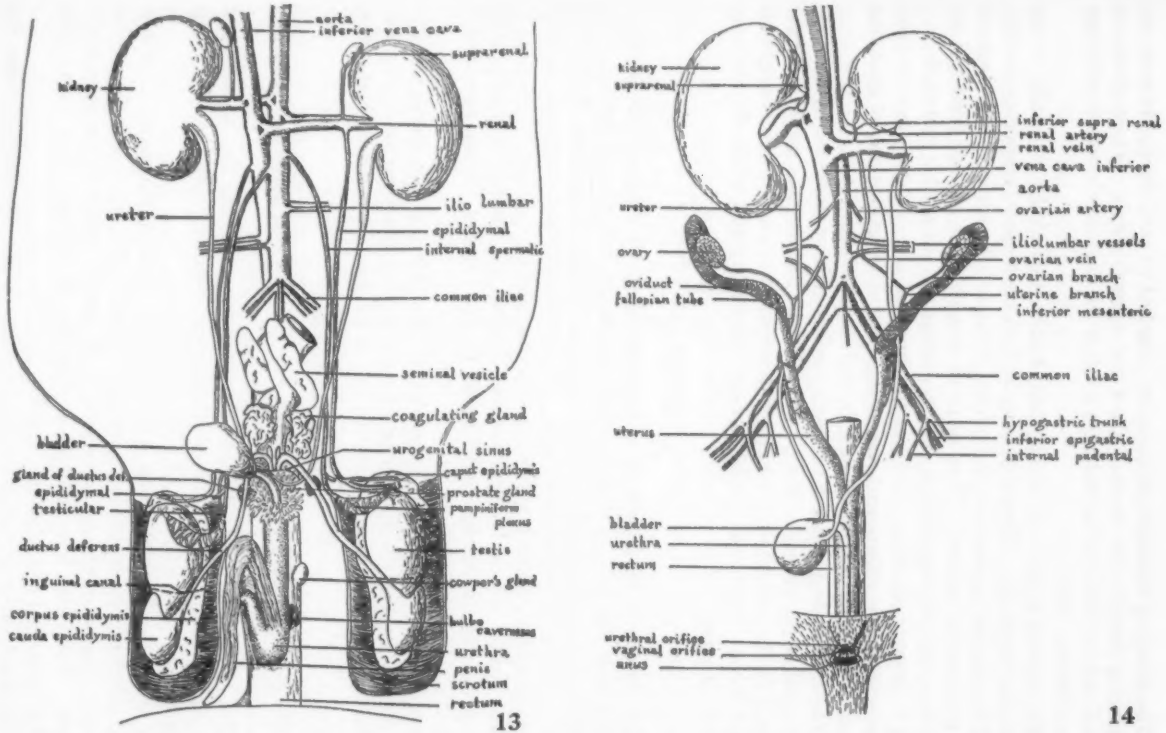


FIGURE 13. The male urogenital system. The seminal vesicles are represented as distended from their normal position.
14. The female urogenital system, showing the condition normal in non-pregnant animals.

The glands of the ductus deferens are attached to each ductus deferens immediately distal to the prostate gland and seminal vesicle. These glands are small and probably aid in producing fluids of the ductus deferens (terminology from Greene, 1935).

The seminal vesicles are rather large bodies, well hidden ventrally by the coagulating glands. They are normally bent back upon themselves dorsally.

The coagulating glands are quite large, lobulated structures, situated ventral to the seminal vesicles. They serve to coagulate the seminal fluid and are necessary for impregnation in certain rodents and some other mammals.

The prostate glands are found at the proximal end of the ductus deferens, appearing quite villous and resembling finger-like projections of glandular tissue completely surrounding the base of the urethra.

The bulbourethral glands or *Cowper's glands* may be encountered by following the urethra posteriorly. They are caudad to the prostate glands. At the base of its duct may be detected the bulbocavernosus and the ischiocavernosus (and corpus cavernosus penis), spongy ridges between which lie the cavernous urethra.

Female

The kidneys of the female are of somewhat the same shape and size as those of the male (fig. 14). The suprarenals are slightly larger in the female. The ureters pass on the dorsal side of the horns of the uterus and enter the bladder on the dorsal surface of the fundus. The urethra leads to a separate external urethral orifice, which is typical of such mammals.

The ovaries are fairly large bodies, circular and smooth in appearance. They lie slightly caudad and laterad to the kidneys. They measured 3 x 2 mm.

The fallopian tubes are quite extensive. The horns of the uterus join just above the level of the bladder and have a median partition for a short distance after their apparent juncture, fusing 0.7 mm. from the vaginal orifice.

THORACIC VISCERA

The thoracic cavity of the kangaroo rat is broad and markedly triangular. Variations from other rodents investigated are slight.

The diaphragm, dome-shaped and muscular, separates the thoracic and abdominal cavities. It possesses the typical circular central tendon of the diaphragm. It measured 22.7 x 19.1 x 0.4 mm.

The lungs.—The right lung is divisible into 4 lobes: the superior, middle and inferior lobes, occupying a position lateral to the heart, and the median or postcaval lobe, which curves around the dorsal surface to the apex of the heart. The latter lobe exhibits a notch for the inferior vena cava. The left lung has but one lobe (figs. 1, 6, 7).

The heart shows no marked variations (figs. 1, 7). The angle between the

long axis of the heart and the trunk as determined by the course of the inferior vena cava was 40 degrees. It measured 13.5 x 9.5 x 8.2 mm. and weighed 0.7 gram.

The great blood vessels from the heart are of a pattern characteristic of most rodents, but show slight variations (figs. 7, 16). The aortic arch gives off 3 main branches; the left common carotid, the left subclavian, and the innominate, which latter divides into 2 branches, the right subclavian and the right common carotid. The arch turns to the left where it continues posteriorly as the descending aorta. The abdominal aorta divides into the typical common iliac arteries and continues as the middle sacral artery. The common iliac divides into the hypogastric trunk and the external iliac, the former dividing immediately into the inferior epigastric and the internal pudental. The obturator artery is a branch of the hypogastric trunk.

The left and right superior venae cavae enter the right auricle together with the inferior vena cava. The azygous also enters directly into the right auricle. No hemiazygous could be detected.

The thymus gland is a large gland situated between the two superior venae cavae. It covers the trachea and the anteroventral part of the pericardium. It is bilobed (fig. 1).

The mediastinum contains the pericardium and heart, great blood vessels, thymus, thoracic duct, lymph nodes and phrenic nerves. Each lung is enclosed by the visceral pleura, which is reflected at the hilus onto the diaphragm and the thoracic wall as the parietal pleura. A dorsal pulmonary ligament supports the lungs from the dorsal thoracic wall. The heart as usual is enclosed by the pericardium.

GLANDS OF THE HEAD AND NECK

It is the intention of the writer to discuss the salivary, orbital and associated glands only as to their positions and appearance. No histological sections were made.

Superficial cervical glands.—The salivary glands, since they are located immediately beneath the skin on the ventral surface of the neck, are included as the superficial cervical glands. The molar and "hibernating glands", being located near the salivary glands, are discussed with them (fig. 15).

The parotid glands are quite extensive, lobular glands, lying ventral and lateral to the submaxillary glands, which they slightly overlap. They extend along the base of the ears in a dorsolateral position, nearly to the anterior surface of the clavicles. The parotid ducts (of Stenson) originate from the union of two main branches. They pass along the external surface of the masseter muscles parallel to the buccal and mandibular branches of the facial nerve and penetrate the cheeks to the oral cavity.

The submaxillary glands are in contact with each other along the midventral line of the throat and slightly overlap. The ducts arise from the internal

surface of each gland and enter the posterolateral border at the side of the masseter muscles. The ducts continue forward to the symphysis menti, where they penetrate the lining of the mouth.

The sublingual glands are closely united and are partly overlapped by the anterior surface of the submaxillary glands. They are compact structures, with ducts that follow those of the submaxillary glands, but open separately from those of the latter.

The molar glands are rather small, located between the skin and the external surface of the mandible, cephalad to the masseter muscles. The name is misleading for their position is close to the incisors and they seem to be associated with those rather than with the molar teeth. No mention has been made of their presence, either in the white rat (Greene, 1935) or in the wood rat (Howell, 1926). Hyman, 1922, indicated that the glands are not present in the rabbit, but described similar glands in a similar position in the cat. It is from this description that the name "molar glands" is applied to these structures.

In the kangaroo rat the glandular mass is quite lobular and has several ducts leading into the mouth cavity. These glands may be accessory parotid glands, but the ducts of the molar glands do not enter with the ducts of the parotid glands. According to Hyman, 1922, the glands are salivary in function.

The hibernating gland—multilocular adipose tissue completes a circle of brown glandular material about the neck, from the region between the scapulae to the midventral line of the neck. It resembles an endocrine gland and does not seem to contain any true adipose tissue. It is probable that this is a thymus derivative, but from which pharyngeal pouch has not been established.

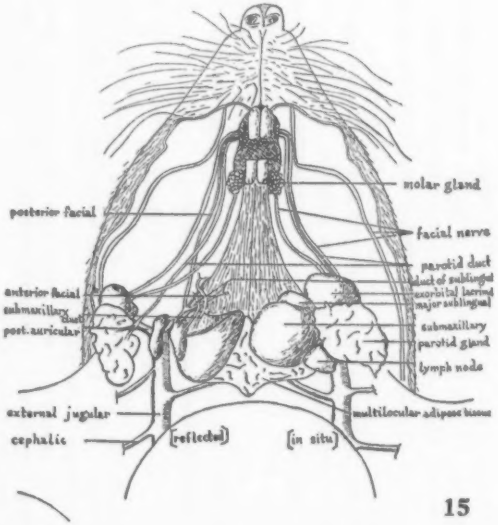
Deeper neck glands.—The deeper neck glands have been drawn without the addition of the musculature (fig. 16), but a few of the main arteries and veins are included. All lymph nodes that were grossly detectable were not included in the figure due to their obscure positions between the musculature.

The thyroid glands are quite extensive, extending from the base of the larynx to the fifth tracheal ring. They have a comparatively short isthmus connecting their lobes on the ventral side, just posterior to the larynx.

The parathyroid glands.—The removal of the fatty tissue exposes two fair sized parathyroid glands closely attached to the right anterior border of the lobes of the thyroid. No others could be detected.

The anterior and posterior cervical lymph nodes, discussed here because of their position, are fairly large and compact bodies. They are embedded in the ventral muscles of the neck.

Glands of the orbit.—No drawings have been made of the glands of the orbit, except the exorbital lacrimal glands. These are rather large and occupy a position dorsal and in close proximity to the parotids. They cover



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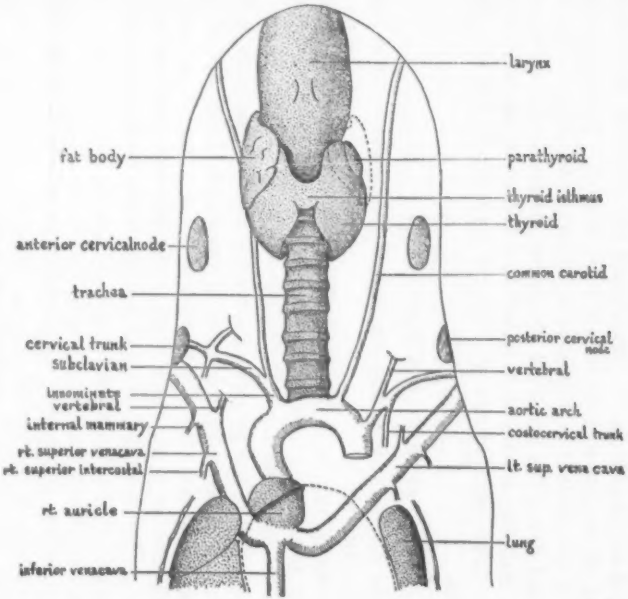

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FIGURE 15. The cervical viscera. The glands on the left are shown in situ; those on the right are reflected to expose the ducts and underlying blood vessels. 16. The deeper viscera of the neck. The right atrium of the heart is drawn diagrammatically to show the entrance of the left and right superior venae cavae and the inferior vena cava.

the beginning of the parotid ducts. Their ducts join the ducts of the intraorbital lacrimal glands and then open on the conjunctiva. The intraorbital lacrimal glands are situated in the posterior angle of the orbit. They are rather small and flat. The harderian glands are located in the orbits, extending about half-way around each eyeball in a horseshoe-shaped manner. They are quite large, reaching downward to the optic nerves, but not quite encircling them.

SUMMARY AND CONCLUSIONS

The following are the outstanding features of the kangaroo rat as compared with the white rat:

1. The stomach lies in a direct transverse plane, very closely pressed against the liver. This is due to the humped condition of the animal and consequent crowding of the visceral organs.
2. The tubular tail of the pancreas follows the inferior vena cava to the sacculus rotundus and is attached by mesenteries to the dorsal part of the cecum and the surrounding coils of the intestine.
3. The small intestine is unusually short, being only twice as long as the large intestine. This is an indication of a high degree of specialization of cells and mucous lining in this region.
4. The cecum is very large.
5. The great length and highly coiled character of the large intestine appears to be peculiar to this rodent.
6. The parotid and submaxillary glands are large structures, which is an indication of the use of dry foods for nourishment.
7. Molar glands are present. These may be accessory parotid glands, developed to supply added moisture for mastication of dry foods.
8. The harderian glands are not as extensive as in other rodents living in a moister habitat.
9. The fallopian tubes of the female kangaroo rat seem to be more extensive and more coiled than is common in many rodents.
10. The multilocular adipose tissue or "hibernating gland" resembles an endocrine gland, with little typical adipose tissue and forms a complete collar about the neck. This gland was poorly named, as it appears to have nothing to do with hibernation. It merely stores great quantities of fat, although it may have other unknown functions.

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OBSERVATIONS ON THE FORAGING HABITS OF BEAVERS

BY LAURENCE E. HINER

Itasca State Park, Minnesota, is located in the north central part of the state at the headwaters of the Mississippi River. It is an area 7 miles square containing 31,768 acres, of which about 5000 acres are water. The topography is rolling and there are many shallow lakes in the park. The streams are small and a few have been dammed by beavers. Beaver lodges, therefore, are restricted primarily to the lakes that do not freeze to the bottom in winter. The shores of the lakes have the common characteristic that they lack steep shores and deep water near the margins. In general the entire shore lines of the larger lakes are suitable for beaver operations.

Trappers had completely eliminated the beaver from this area before 1880, but in 1901, according to Dr. T. S. Roberts (1935), three beavers from Canada were released in Itasca Park. They have been rigidly protected since that time. During the fall and winter of 1934–1935, W. S. Feeney (in mimeographed report, 1934), Game Technican of this area for the National Park Service, reported 123 used and abandoned lodges and 750 individual beavers within the park area. In summarizing his survey, Feeney emphasized that an over-abundance of beavers was present. The population is so great that many animals are forced into shallow lakes and ponds in order to obtain aspen for food.

Investigations during the summer of 1935 at the Forestry and Biological Station at Itasca Park verified the work of Feeney. The beavers were, ecologically speaking, eating themselves out of their environment. Thus, they were forced to travel some distance on land to obtain aspen for food. Warren (1927, p. 131) stated that the greatest distance from the water at which he has found trees cut by beavers was at Lily Lake, Estes Park, Colorado, where trees had been felled more than 400 feet from the shore. Vernon

Contribution from the Forestry and Biological Station of the University of Minnesota at Itasca State Park.

Bailey (1927, p. 6) said: "Trees are commonly found cut as far back as 10 or 20 rods from the shore, but tracks, trails, or traces of beavers are rarely found farther from the water than that". Harry D. Ruhl (1931) of Michigan reported that, with an abundance of aspen, beavers seldom venture beyond 300 feet from the shore. H. U. Green (1936) of Manitoba, Canada, has stated that beavers will abandon their lodges if they have to travel more than 75 yards for aspen trees.

The beavers at Itasca Park constructed canals whenever possible, and to the greatest length feasible, but the number of these was so small that they are not considered in this paper. There was no correlation between the distance travelled in the water compared to that travelled on land. This distance by water varied from 0 to 1200 feet, the latter being the distance across the west arm of Lake Itasca. Evidently the towing of sticks in the water presents no problem to the beaver.

The method of obtaining data on the distances beavers will travel to obtain food was as follows: First, only inhabited lodges were considered; second, the area adjacent to the lodge was scouted to determine the extent of the distance that beavers work from their lodges. When the limit of the beaver work was determined the distance nearest to the water was measured by means of a 50-foot tape. Beavers in all but two instances worked first back from the shore nearest their lodge, and after completing the work nearest the lodge they started to work laterally along the shore. Diagonal hauls of aspen were made at first, but as the distance became greater it was found that beavers dragged the aspen limbs directly to the water, and then towed them in the water along the shore to the lodge. This practice was started before reaching a distance of 200 feet to the right or to the left of the lodge. Thus, for a single lodge it was possible to obtain three measurements of distance; one directly back from the shore, a second 200 feet or more to the left, and a third 200 feet or more to the right of the lodge. In the case of a series of lodges located near one another along the lake shore, only measurements directly behind the lodges were taken. The other possible measurements were omitted because it was not known from where the beaver came to do the cutting.

On lodges located in creeks, only two measurements at most were taken—that of the farthest cut tree on each side of the creek.

These restrictions left 55 measurements on 35 lodges as a basis for calculating the distances travelled on land. It was noted that beavers cut trees up the valleys between the more steeply sloping land benches bordering the lake. It appears that the beaver have a dislike for the steeper slopes. These 35 lodges were located on a Geological Survey map. This map is scaled one mm. to 50 feet. Contour lines on it represent 5 feet of elevation. The contour line nearest the distance plotted on the map to where the tree was cut was considered to be the altitude.

On two occasions it was found that the beavers, after cutting all of the aspen on the upward slope away from the shore, had reached the top of a knoll and had started down the opposite side of the slope. The greatest decline in slope was about 4 in 150 feet of distance. At other times cutting ceased when the top of the rise was reached, even with aspen beyond.

The arithmetical mean of the distances travelled from the water is 267 feet, and 39.5 feet is the average altitude above the water for the average distances travelled on land. The maximum distance travelled was 453 feet.

It is realized that in a calculation of this nature a correlation between the distance away from the lake and the height above the lake level is inevitable. But one cannot overlook the fact that the beavers which selected sites for their lodges where aspen trees grew on a definite incline were able to continue living in the lodge longer than those beavers which located their lodges near aspen trees growing on land that rose only a few feet for some distance away from the shore line. This conclusion is based on field observations of 11 abandoned lodges. The distance travelled back from these abandoned lodges on the nearly level shore line rarely exceeded the average distance of the present active colonies, amounting to 267 feet.

The longer hauls of aspen by beavers on the land were always accompanied by an incline greater than 39.5 feet, the average elevation of the entire group of observations.

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HIBERNATION OF THE STRIPED SKUNK IN IOWA

By Lyle F. Selko

Observations on the hibernation of the striped skunk, *Mephitis mesomelas avia* (Bangs), were begun in the fall of 1936 and continued until the spring of 1938 as a part of the investigation of the ecology and management of this animal. The area under observation was located within a radius of 10 miles of Ames, and particularly in territory north of the city along Squaw Creek and Skunk River. The project was under the supervision of Dr. George O. Hendrickson, Assistant Professor in Wildlife Management, and Dr. Logan J. Bennett, Associate Biologist, U. S. Biological Survey.

In the fall of 1936, the first indication of coming hibernation was noticed on November 27. This observation was made at a woodchuck den located approximately three-fourths of a mile north of Ames on the east bank of Squaw Creek. The bluegrass (*Poa pratensis*) around the entrances of this den had been closely cropped and pulled within a radius of 8 feet. Bluegrass and oak leaves were strewn at the entrances and in the den channels. On April 17, 1937, this den was excavated by the writer. Much leafy and grassy material, as well as numerous skunk scat remains, was found in the large cavity. These scats, judging from the state of decomposition and from the contents of adult grasshopper remains which were very comparable to the fall scat analysis by Selko (1937), were probably deposited there in the fall of 1936. It was apparent from talks with trappers and farmers who had dug skunks from dens in the past (when such a practice was legal), that this was a typical hibernating den for a number of skunks. According to these men a typical hibernating nest was of grass and leaves in a wooded area, and, in other areas, entirely of grass. Also, according to the informants, leaves and grass usually were crammed into the cavity to form a large bulky nest. Concerning the gathering of nest material for hibernation, Seton (1929) wrote: "The skunks on my fur farm are the most enthusiastic nest builders. No matter how much soft grass or long hay is left in the yard, the mother will chew it fine, and work on it till they have it all jammed into the den". Trappers in the vicinity of Ames also mentioned that the gathering of materials by skunks for the hibernating nest for the winter of 1936–1937 was noted by them throughout most of the month of November.

In the fall of 1937, the first indication of gathering of nesting material by the skunks for hibernation was noted by the writer on October 15, at a den in a wooded creek pasture. Leaves and bluegrass, as in the previous fall, were used. The leaves collected evidently had fallen from nearby oak trees. The bluegrass near the den was partly sheared and partly pulled for the

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nest making. In the following two weeks of October many such indications of coming hibernation were noticed.

The mean maximum, minimum, and average monthly temperatures for the winters of 1936–1938 are listed in the table for correlation with hibernation periods.

In each of the winters when the studies were carried on, a cold spell occurred in the first two weeks of December and a corresponding cessation of skunk activity was noted until the weather had become warmer. In 1936, no movement was discerned from December 7 to 13, during which time the temperature ranged from a mean maximum of 26.96 degrees F. to a mean minimum of 4.74 degrees, with a mean average of 15.86. In 1937, no activity was noted from December 5 to 14, during which time the temperature ranged from a mean maximum of 18 degrees F. to a mean minimum of 3.13, with a mean average of 10.57 degrees. Hamilton (1937) has observed similar denning up of skunks in New York during brief cold spells

WINTER TEMPERATURES, 1936-37, 1937-38

MONTH	TEMPERATURE (F°)					
	Mean maximum		Mean minimum		Mean average	
	36-37	37-38	36-37	37-38	36-37	37-38
December	37.6	29.3	19.3	14.3	28.45	21.8
January	21.8	28.8	1.7	10.48	11.75	19.6
February	27.1	36.11	9.1	20.89	18.1	28.5
March	40.9		24.8		32.8	

in the early winter, with activity again resumed when the weather became warmer.

Eleven active skunk dens were under the writer's observation at the beginning of hibernation in the winter of 1936–1937. In the spring of 1937, only three of these observed dens showed indications of the resumed activity of hibernating skunks. Trappers had been active in the vicinity in which most of the observed dens were located, and the large number of inactive dens was due in the most part to the trapping of the resident skunks. It is possible that some other unknown mortality factors also were operative. Therefore, in the spring of 1937, the determination of the time of the termination of the hibernation period depended upon the following factors: (1) scattered tracks noted, (2) finding of fresh skunk scats, and (3) trappers' observations.

January and February, 1937, were cold and cessation of skunk movement began at the end of the first week, when the mean minimum temperature dropped to the zero mark and the average mean temperature was 7.9 degrees F. Throughout the remainder of January and February no activity was

recorded. The first two weeks of March were rather mild, but the consistently cool, wet weather of the last half of March continued into the second week of April. These months of January, February and March were listed as below normal in temperature.

The first indications of skunk activity at the dens under observation in the spring of 1937, of which only three dens showed signs of returning activity, were the tracks and fresh diggings around them in the third and last weeks of March. Some scattered tracks were noted in another territory during the middle of March, but no scat collecting took place until the last week of March. Trappers consulted forwarded the information that they had noticed skunk tracks also throughout the early part of March. This late activity at the dens under observation seemed a bit unusual, as the weather at that time was colder and more disagreeable than during the early weeks of March. However, the late activity at these particular dens might be explained by the fact that they may have contained yearling animals and because the immature animals (Hamilton 1937) usually sleep throughout the winter, rarely venturing from their dens until mid-March.

From the previous data, the months of the most profound hibernation were January and February, when the mean maximum temperatures ranged from 21.8 to 27.1 degrees F., the mean minimum temperatures from 1.7 to 9.1 degrees, and the mean average temperatures from 11.75 to 18.1 degrees.

At the beginning of hibernation in the winter of 1937–1938, 12 active dens were under observation, 8 of which showed renewed activity the following spring. Five new active dens were located in the spring at the termination of the hibernation period, thus making a total of 13 dens under observation for data on the time of renewed activity of the skunks in the spring of 1938. Therefore, but little dependence could be placed on the various factors used to determine, as nearly as possible, the end of the hibernation period in the winter of 1936–1937. Cessation of activity began the first week in January and hibernation was completed at the dens under observation from January 6 to February 4, during which time the mean maximum temperature was 28.34, the mean minimum 10.1, and the mean average 19.3 degrees F.

In comparing the hibernation periods of the two years, several interesting facts were revealed. The length of the hibernating period in 1936–1937 was almost double that of 1937–1938. The two winters were entirely different, but yet the periods of most complete inactivity of the skunks had very similar mean temperatures. The winter of 1936–1937 had two months, January and February, with below normal temperatures, whereas the winter of 1937–1938 had a period of only about one month, January 6 to February 4, with rather low temperatures. This period of low temperatures in the winter of 1937–1938 almost matched the temperatures of February the year before. Skunk hibernation in these two winters coincided with these periods of prolonged rather low temperatures. In both years the period of hiberna-

tion appeared to begin with an equally abrupt drop of temperature and to end in the spring with a corresponding abrupt rise of temperature. In the third week of February, 1937, the temperature rose until the maximum readings were just above freezing, and it was expected that unobserved movement could have occurred because of a lack of active observational dens and because the hibernation period was already more than one month in length. Yet this week may be compared with the third week of January, 1938, when the weather was yet even warmer and, decidedly, no activity was evident at any of the 12 dens under observation. It is therefore apparent that brief warm spells in the midst of the hibernation period may be as noteworthy for the absence of skunk activity as are brief cold spells in early winter, as exemplified by the cold spells in both years during the early part of December.

Temperature is probably not the only factor affecting the skunk's hibernating period, but it is undoubtedly one of the most important. It is known that the hibernating period is longer in the northern states and much shorter, if occurring at all, in the southern states. Cuyler (1924) has written concerning the striped skunk (*Mephitis mesomelas varians*) in the vicinity of Austin, Texas: "In this climate skunks are abroad all winter except for brief cold periods, hence cannot be strictly said to hibernate". Hamilton (1937) believed that low temperatures are the inciting cause of sleep, that females are confirmed hibernators, and males more or less active throughout the winter, with individual mature animals rarely hibernating for more than one month at a time. In comparing the results of the writer's observations with the abovementioned findings of Hamilton, it appears at first sight that there is considerable variance. However, there is the very important factor of temperature that shows considerable variation between the two states. In January, when hibernation usually takes place both in New York and in Iowa, it is found that the average temperature in the winters of 1931–1932 and 1933–1934 at Ithaca, New York, (Hamilton, 1937), as compared with that of Ames, Iowa in the winters of 1936–1937 and 1937–1938, ranged approximately 15 to 20 degrees higher. This great difference in temperature during the usual hibernating period is sufficient in itself to be responsible for many variations. The writer has accorded no differentiation to the length of hibernation of the males and females because the data were not at hand. It is suspected that females have longer periods of hibernation than the males in this territory also, as indicated by the predominance of males caught by trappers throughout the trapping season; but as the trapping season ended on January 10 and the hibernation period was under way at that time during the winters of 1936–1937 and 1937–1938, further data were unavailable.

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VERMONT JUMPING MICE OF THE GENUS ZAPUS

BY CAROLYN SHELDON

Especially adapted for escape from enemies in the tall grass, jumping mice of the genus *Zapus* are often conspicuous when scared from their nests because of their long jumps, promoted by slender but powerful hind legs and balanced by a tail much longer than the body. Often the nest is in such a place that secure shelter in a clump of grass or a stone wall is within easy reach, but farmers cutting hay rob those in the open fields of available cover and many may be seen jumping, apparently aimlessly, to escape the mower. Somewhat protected on account of their yellowish sides and darker blackish back stripes, color much like the ripe meadow grass itself, they seem to disappear until close approach makes them jump again. This habit of sitting immovable after a jump or two which hides the white underparts, is also a measure of safety, but, by slowly creeping up, one may easily clap a hand over the mouse. Three farmers near Woodstock captured them for me in this way. They are gentle and will not bite unless held too long or handled roughly. To the inexperienced naturalist or to the casual observer, they are often mistaken for frogs or even grasshoppers in the tall grass, because their leaps are so swift and sudden as to make recognition difficult.

At dusk or after dark *Zapus* cautiously crawls away from its nest to the cover of woods or bushes where it may find food and water without danger of detection by night marauders. If *Microtus* also inhabit the field, their well beaten runways under the grass afford paths frequently used by *Zapus*. The latter were never found in the deep woods, but along the edges. Fred Osgood at Rutland, Vermont, found them on Mt. Killington, in a meadow at about 3800 feet altitude.

In the summers of 1934–1937, *Zapus hudsonius hudsonius* was studied in the vicinity of Woodstock, Vermont. The country covered is about 1200 feet in altitude and includes steep hayfields, divided from each other by strips of bushes and saplings and broader strips of hardwood forest. Many of the fields are now overgrown with small white pines, poplars, willows, and white birches, also with goldenrod, ferns, and other common meadow plants. Stone walls covered with wild grapevines are abundant and there are numerous brooks and small rivers.

The mammal community of the area included woodland jumping mice, deer mice, meadow-mice, house mice, house rats, chipmunks, red, gray, and flying squirrels, woodchucks, short-tailed shrews, masked shrews, skunks, raccoons, weasels, mink, red foxes, bobcats, and deer. Of these the short-tailed shrews, red foxes, bobcats, weasels, mink, and skunks are enemies of the jumping mice. Owls and hawks also undoubtedly prey upon them.

Acknowledgments.—I am greatly indebted to the farmers working in the vicinity of Woodstock and Pomfret, Vermont, for giving me information on jumping mice and allowing me to set traps in their fields. Among these I wish to express my gratitude especially for the help given me by the late Frank Lyford of Chelsea, and Philip Austin of Woodstock. Deep appreciation is due Vernon Bailey for his constructive criticism in the writing of this paper, and to William H. Burt of the Museum of Zoology, Ann Arbor, Michigan, whose suggestions on studying home range have been invaluable. For using other important information I am indebted to Wendell P. Smith, of Wells River, and Fred Osgood of Rutland, Vermont. I wish to thank the University of Michigan for the use of its equipment. I am indebted also to Louisa G. Sheldon and Harold Austin of Woodstock, Vermont, for their care of captive mice in my absence.

Methods.—Metal spring-floor traps were used. Mice caught in some localities were kept in captivity and those in other places were etherized, marked in the field, and released where taken for the study of home ranges. For this later study more than 100 traps were set 50 feet apart around 3 fields, covering about 15 acres. All of the mice were taken around the edges of these fields near brooks or stone walls, under wild cherry shrubs, hardwood saplings, and thick ferns. Under these were well worn runways several inches wide, used constantly by *Zapus*.

In 1934–1937 jumping mice were taken in numbers along a stone wall under bushes, as described above, but never the same individuals in the same localities from year to year. Always there was a new group.

Mice of all kinds seemed more numerous on rainy nights or after a heavy dew. At first, jumping mice seemed loath to enter traps and often would not be caught for more than a week after the traps had been set. Having entered more than one, they usually continued to visit others along the line. If they remained long in the traps they were sometimes so weak from exposure that they finally died.

Home range.—Because of their very local distribution and the small number of *Zapus* caught in the years of study, home range was impossible to determine, even in 4 years.

The following are examples of *Zapus* caught most often. In 1936 alongside a stream I took a male first on June 21; second capture June 23, 30 yards distant; third, June 25, 30 yards distant; and fourth, June 28, 50 yards distant, at which time he was perfectly well, but was never recaptured.

Another male *Zapus* was first caught June 22; second capture, June 23, 90 yards distant; June 25, 30 yards distant; and June 28, 90 yards distant. He was then lively and in good condition, but was never recaptured.

Another male *Zapus* was first taken June 23; second capture, June 24, 60 yards distant; third, June 26, 10 yards distant; and fourth, June 24, 30 yards distant. This last time he was torpid in the trap and a heavy rain was falling.

A male *Zapus*, first caught twice in 1936, was recaptured in 1937, first on August 19, then, August 21, 30 yards distant, August 23, 300 yards distant, and finally on August 24, 100 yards distant.

In 1936, of 10 *Zapus* caught, 2, a male and a female, were never recaptured, 3, 2 males and 1 female, were recaptured once, 1, a female, was recaptured twice, and 4, all males, were recaptured 3 times. It can be seen that females either were less numerous than the males or did not exhibit such a tendency to wander.

E. T. Seton (1909, p. 590) stated that he believed *Zapus* travels "farther than any other of the mice". M. T. Townsend (1935, p. 91) wrote that "results indicate a highly variable wandering tendency for this species. Sometimes one sex, sometimes the other, gives the higher value in this respect, but frequently a rather high wandering tendency is suggested, correlated perhaps with a tendency to concentrate its population as the habitats become dry in the course of the summer". From the results of my work, it seems as though they must wander about considerably from month to month, as all those caught most often were taken during a single month in only one locality.

In 1934 I removed from the edges of the fields 14 *Zapus* and marked and released 3 of them. Of the captive individuals, 3 escaped. One of the latter was recaptured the following year (1935) at the edge of a hardwood strip extending between two fields, instead of under the bushes where he was taken previously, about 100 yards distant.

Abundance and fluctuation.—In 1934, I caught a total of 17 *Zapus*; in 1935, 3; in 1936, 10. In 1937 there was a marked decrease, and I took only one in August, an individual that had been marked the year before. That summer farmers reported them as absent from the haying fields where previously they had been numerous. Fred Osgood, of Rutland, Vermont, wrote in a letter dated October 11, 1937: "Small mammals have been scarce here and in Rockingham this year. . . . Most of the trapping grounds are very dry with leaves and top soil washed off by violent rains early in the season. . . . A few *Zapus* have been taken. . . . One *Zapus* was taken in a stone wall. . . " With unseasonable floods in January and early spring, hibernating animals may well have been drowned.

Jumping mice seem to have a curious way of evacuating a field where they were plentiful and no one knows where they go. In 1935 a farmer in Pomfret, Vermont, telephoned me to say that jumping mice were "jumping all around"

where he was haying. Unfortunately, I was unable to go until late afternoon, after the hay had been cut and raked into piles. Not a mouse was apparent anywhere in the field or under the piled hay. There were many small holes around the edges of the field, but traps set there yielded only *Peromyscus* and *Microtus*. The *Zapus* in this case, to reach other fields, must either have crossed wide pastures with no shelter and always with many grazing cows, or they must have entered the adjoining woods to find shelter. I also kept traps set there from August 4 to September 11, but not one *Zapus* did I catch.

Signals.—Arthur and Ruth Svihla, writing of *Zapus trinotatus trinotatus* (1933, pp. 131–134), reported that "On several occasions these rodents were seen to make a drumming noise by rapidly vibrating their tails against some resonant body as the bottom of a tin can or shreds of paper used for nesting purposes. They also make a squeaking noise when fighting." I have often noticed the drumming noise as the tails were vibrated against dry leaves.

Orientation.—After a mouse had been etherized and marked in the field, he would lose his sense of direction and would usually start off aimlessly toward the open field or away from the stone wall, falling over leaves and sticks. In a few seconds, when he had regained full consciousness, he made immediately for shelter—usually a stone wall.

On May 27, 1934, I caught a *Zapus* in a hay meadow near a small hole in the grassy bank of a brook, overgrown by small willows. I released him without etherizing him. He hesitated a second, then half ran and half leaped, going past the hole near which he had been caught, upstream toward the denser undergrowth, skipping across two pools of running water an inch or more in depth. When he disappeared I investigated the place where he escaped from sight and found that there the brook ran underground for a few feet. Whether the mouse went into this place or jumped over it and made away on top I was not able to ascertain definitely, but he appeared to have gone underneath. W. J. Hamilton, Jr. (1935, p. 190) wrote: "Both species (*Zapus* and *Napaeozapus*) swim well and can remain in the water, swimming strongly, for four or five minutes, perhaps longer."

Philip Allan of the U. S. Soil Service reports that in northern Minnesota he saw many *Zapus h. hudsonius* rapidly swimming 3 or 4 inches under water in crossing a deep ditch 3 or 4 feet wide. They swam upstream using only the hind legs. This occurred in July, about 2:00 P.M.

It is interesting to note, as W. H. Burt has pointed out to me, how thoroughly small mammals know the territory over which they roam. There was no hesitation on the part of *Zapus* that I observed when frightened from their nests or released from traps, as to where shelter was to be gained. If they did not disappear in a stone wall they often vanished in a clump of grass that had no apparent opening, or into a small hole unnoticed by the casual observer. I have torn up the clump where one went and tramped down the surroundings, but all to no avail.

Parasites.—W. J. Hamilton, Jr. (1935, p. 191) wrote: "Jumping mice are not as much subject to external parasites as other small rodents, . . . A louse was once taken from *Zapus.*" I have found a number infested by larva of the bot-fly (*Cuterebra fontinella* Clark). These larvae are found just below the surface of the skin and they emerge through a small round hole. Apparently they do not harm the mice, as one *Zapus* lived for many months after the larva had emerged, and the hole soon healed and was not visible.

Food.—Besides the usual grass seeds found in their natural habitat, I put a red salamander in a cage containing 2 *Zapus* and they tore the skin and ate the viscera. Frogs and snails put in the cages were not touched. Usually they never eat dead mice, but in 1934 a *Zapus* either died or was killed in a cage, and I found him half eaten. This is the only time in the years during which I have studied jumping mice that I found them to be at all cannibalistic, except for eating their young. Nearly all berries, including strawberries, blackberries, raspberries, and red baneberries, were eaten, but blueberries, currants, and gooseberries were refused. However, W. J. Hamilton, Jr. stated that "An adult male (*Zapus*) collected in a swamp at Freeville, New York, had been feeding extensively on blueberries. . . In captivity the animals freely ate currants. . ." My *Zapus* were extremely fond of sunflower seeds and when fed a mixture of these, rolled oats, and canary seeds, would always burrow down into the food can and select the sunflower seeds to the exclusion of all others. They also appeared to be fond of powdered milk, even when mixed with a few drops of cod liver oil.

Nests and young.—During the summer, *Zapus* live in above-ground nests built in open meadows. One was found on June 23, 1934, at the edge of a small hayfield, and when disturbed the mouse could reach the shelter of bushes and a stone wall within two short leaps. The nest was globular and closely woven of fine dry grass and bits of moss, and was so like hummocks of grass near it that it was hardly detectable. The entrance on the side was very inconspicuous. It was not more than 4 inches in outside diameter, and scarcely more than 2 inches inside. When the nest had once been opened the owner did not return, nor were set traps disturbed in the nearby open field.

On June 24, 1935, I found another nest in the same meadow, but in a slightly different situation. When disturbed the mouse entered a crack in the stone wall after two short jumps. I did not open this nest at first, but hay was cut all around it later in the day and the mouse did not return. The following are the exact measurements of this nest: Circumference of base, outside, 11.5 inches; circumference over top, 6 inches; inside width and length, 3 inches; inside height, 3.5 inches.

In 1936, no nest was found in that field. In another place, on August 14, a mouse was disturbed on 2 or 3 days in succession in the same location. I discovered the nest, closely woven of coarse and fine grass and dry leaves, well sheltered by a hummock of orchard grass. It was not situated in the

FIG. 1

FIG. 2

FIG. 3

FIG. 1. *Zapus* builds nests in broad hay fields, but is to be caught only around the edges. FIG. 2. Nest found in the middle of an open field. FIG. 3. Nest after being opened through the top.

thickest part of the field, but in a clump of grass among a scant growth of sensitive fern (*Onoclea*). The mouse was within one easy jump of thicker cover.

Wendell P. Smith, of Wells River, wrote that on September 16, 1926, he "dug up a nest of jumping mice (*Zapus hudsonius*). It was located in a potato hill, some three or four inches below the surface of the ground and contained seven young. The latter showed little of the contrast between the back and sides apparent in the adult, the back being scarcely darker. They were blind and a tail measured three inches in length. The mother ran away when the nest was exposed and did not return. . . .Record for September 19, 1928: four individuals were in the nest, two at least were not more than two-thirds grown. They seemed rather stupid and activity came slowly. . . The location was well out in a 50 acre field with the nearest woods some seven hundred feet distant."

Again he wrote: "Under date of October 13, 1932, I find the following (note): A cat brought in an immature male jumping mouse (*Zapus hudsonius*). Age determined by size and ochraceous pelage. Length, five inches of which one and a half were in the body and the remaining three and a half in the tail. Temperature at time (10:15 A. M.) was thirty-eight degrees with snow flying. My notes also state that the bottom of the toes were purplish". This is a remarkably interesting note because the date is so late in the fall for an immature jumping mouse and the temperature so low. The mouse was probably not hibernating because it was so young—I should judge not more than three weeks old at the most.

On July 1, 1936, Barrie Borden, in Woodstock, Vermont, caught a young female *Zapus* in front of his house in the long grass among a heap of débris collected in a wheelbarrow from the fields. She was very tame and sat in my hand without fear. She easily drank milk or diluted cream from a medicine dropper, consuming one dropperful at night and another in the morning, but none during the day. She also nibbled at some flakes of rolled oats.

I kept her in a small felt-lined box and she was able to crawl into some cotton and make a small hollow for a nest. On July 3, one of her long hind legs got tangled in the cotton and broke, so she was unable to stand up and eat, or wash her face and hands, but the leg dragged behind her as she hopped about. That night she died, probably from lack of proper food. Her measurements were as follows: Total length, 180.5 mm.; tail 80; hind foot 22. She was probably 3 or 4 weeks old. The young one found by Mr. Smith on October 13, 1934, was smaller than this one, measuring about 2 inches less in total length.

It was found to be extremely difficult to breed *Zapus*. They never mated in captivity to my knowledge. One was caught July 15, 1936, and gave birth to 7 young the following night. Immediately thereafter she emerged from her nest in the cage and sat huddled in one corner, paying no attention

FIG. 4

FIG. 5

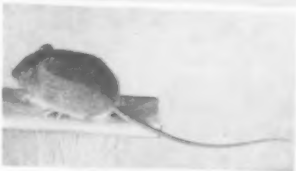

FIG. 6

FIG. 7

FIG. 8

FIG. 4. Side view of a *Zapus* in the hibernating position; photograph by Vernon Bailey. FIGS. 5 AND 6. The long tail is used for balancing and as a rudder. FIG. 7. A *Zapus* crouches in the effort to escape detection. FIG. 8. Long hind legs for leaping and short fore legs; photograph by Vernon Bailey.

to the faint whimperings of the wriggling babies. On July 18, their cries were still heard, but the next day all 7 were found dead and one had been partly eaten. That was the only litter of *Zapus* born in captivity. Each young weighed seven-tenths of a gram.

Hibernation.—As yet I do not feel that enough has been done on hibernation to justify definite conclusions, or to give details of my few experiments. In nature, *Zapus* leaves its summer nests in the open fields and burrows into the ground for its winter sleep. Just when this begins is uncertain. Individuals differ and probably the local conditions at its home have something to do with it. In captivity my *Zapus* began digging in their cages and began hibernating during the last part of September, when the weather turned colder and the temperature dropped to between 40 and 50 degrees F. Even then they awoke frequently before settling down to a sleep of more than 2 or 3 days.

When the winter sleep ends is also undetermined. W. J. Hamilton, Jr. dug up a hibernating jumping mouse near Ithaca, New York, the last of April, and I have caught them the last part of May and found them sometimes hibernating in the trap. Although the summer in Vermont is often as cool as the early spring, the *Zapus* did not become torpid at all. This seems to indicate that in Vermont they may come out for a few days in April or May, or earlier, and then perhaps return, probably for only a few hours, to sleep from time to time when the air becomes too chill for comfort, or when food is scarce.

Their burrows must be some distance from the numerous streams, which usually overflow their banks when the snow and ice melt.

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NOTES CONCERNING MAMMALS COLLECTED IN YUCATAN

By Robert T. Hatt

Field work in the Yucatan peninsula was conducted by the writer and Marcelle Roigneau Hatt from October 9 to December 17, 1929. Our main objective was an exploration of cave deposits for mammalian bones which might show relationship with faunas of the West Indies or indicate something of the recent paleontological history of the land. Incidental to this collecting some more recent animals were obtained and among them a few mammals. It is chiefly on these that the following report is based.

We landed at Progreso, proceeded immediately to Merida, and in a few days moved out to Chichen Itza, type locality of many mammals, where we collected for 16 days. Here we secured the new genus and species of tree rat, *Otonyctomys hatti* Anthony, and such rarities as *Marmosa m. mayensis*, *Cryptotis mayensis*, and *Grison canaster*. From Chichen we moved back through Merida to the hacienda of Yocat near Ticul, then to Oxcutzcab and Calcehtok. From these latter localities, all lying at the foot of the gentle rock fold known as the "Sierra", many short trips were made to the hill caves, but little mammal trapping was done. At no time were we far away from the influences of civilization, but at the same time never far away from the low thicket composing the Yucatan jungle.

Expenses were met by a grant from the Angelo Heilprin Fund of the American Museum of Natural History, of which we both were staff members at the time. All specimens referred to are in the American Museum; skins, skulls, skeletons, and most alcoholics in the Department of Mammalogy, a few alcoholics in the Department of Comparative Anatomy, and external parasites in the Department of Entomology.

Below the scientific name I have occasionally placed the vernacular (Mayan or Spanish) name or names which we found in use for the species.

Reports on mammals of Yucatan are not many and each collection has been strikingly dissimilar. For that reason these notes are considered of interest. The foremost synoptic reports are listed at the end of this paper.

It is a pleasant duty to thank the authorities of the Carnegie Institution of Washington for gracious permission to use their Chichen Itza headquarters as a temporary base, and to acknowledge the friendly help of the numerous Yucatecans who extended the courtesy of an open door in their haciendas, or by numerous other kindly acts aided two collectors new to the tropics and strangers to a land where Mayan is an essential to easy travel. Dr. Harold E. Anthony of the American Museum has generously granted permission to publish these notes. For identification of the bat flies I am indebted to Doctor C. H. Curran of the American Museum and Doctor Joseph Bequaert of the Harvard Medical School.

Although no great diversity of mammal habitats was apparent about our

main collecting station, Chichen Itza, different trap lines produced quite different catches. One line that ran through *Convolvulus*-covered low jungle in "old Chichen" yielded several *Heteromys* and but one *Peromyscus*. From a dry cenote, whose vegetation appeared little different from that of the above line, came *Ototylomys*, one *Peromyscus* and one *Heteromys*. A line run through an extensive "karst" depression yielded nothing, although there were numerous trees, abundant shelter, and a rich though comparatively vine-free vegetation. Traps placed along the upper border of the cenote of Xtolók caught *Peromyscus*, *Marmosa*, and *Cryptotis*. Another trap line through somewhat drier forest along a low ridge bearing little soil and little undergrowth produced *Peromyscus* only.

Marmosa mexicana mayensis Osgood. Chichen Itza, 1. This, the second known specimen, was taken in the shelter of a rock ledge near the upper border of the Xtolók cenote. Its stomach contained the remains of insects. Another *Marmosa*, possibly this species, was seen in the old city of Chichen while night hunting with a headlight. When first discovered it was about 18 inches up in a small bush, but ran down into the rubble of a ruin before the gun could be fired. Its eyes shown brilliantly red. The specimen, a young female, measured 234 x 134 x 18 x 6 mm.

Didelphis yucatanensis yucatanensis Allen. *Zorro*. Calcehtok, 1; Chichen Itza, 6; Oxkintok, 1. This species was new to the collections of the American Museum. The specimen from Oxkintok was secured in the tortuous underground passages of the ruin known as El Laberinto.

A dead opossum was found in a hole among some rocks bordering a railway cut near Yocat. It was obvious that the animal had been about two-thirds ingested by a large snake, presumably a boa, and recently regurgitated. However, in the zoological park at Merida, an opossum placed in a cage with a large boa went to sleep in the center of the snake's coils. For at least two days it was unmolested. The largest specimen, an adult male from Chichen Itza, measured 740 x 340 x 57 x 50 mm.

It is a belief among some of the Yucatecans that the darkly colored specimens taste bad when eaten but that the lighter specimens are delectable.

Cryptotis mayensis (Merriam). Chichen Itza, 1. This specimen, the second known, was taken along the rim of the Xtolók cenote. Skulls and mandibles were numerous in the superficial cave deposits of the "Sierra" below owl roosts. The mammary formula is 0-0-3 = 6. Measurements of the specimen, an adult female, are 118 x 28 x 11 mm.

Peropteryx macrotis macrotis (Wagner). Calcehtok, Actun Spukil, 2; Chichen Itza, 13; Oxcutzcab, Actun Loltun, 4. This is apparently the first record of an emballonurid bat from Yucatan. Specimens from Chichen Itza were secured in the ruins, notably from dark recesses of the Caracol, the Monjas, and the Temple of the Black Figures. At Oxcutzcab they were taken from a dark inner chamber of Actun Loltun, whereas at Calcehtok the bats were in the light zone of Actul Spukil.

Glossophaga soricina leachii (Gray). Calcehtok, Actun Spukil, 1. The specimen was taken from an inner chamber of this cave, into which no daylight penetrated.

Artibeus jamaicensis yucatanensis (Allen). Chichen Itza, 1; Oxkintok cave, 5; Oxcutzcab, Actun Coyok, 5; Yocat, 5. All individuals were taken in caves except that from Chichen Itza, which was secured in a room of the Monjas. From a Yocat specimen parasites of the species *Trichobius dugesii* Townsend were taken.

Desmodus rotundus murinus (Wagner). Calcehtok, Actun Spukil, 1; Oxkintok, 4. The first specimen came from a lightless chamber of the "Cavern of the Mice". Those from Oxkintok were taken in the dark chambers of "El Laberinto", where they were literally picked out of the air as they flew about in the beams of our headlights. The affair, however, was not a bloodless one. Natives at Chichen Itza stated that chickens sometimes die as the result of too much blood-letting by the vampires.

Diphylla centralis Thomas. Yocat, 3. This species has not hitherto been reported in Yucatan. One of the specimens was taken in what I named Manhole Cave, two miles south of Yocat; the others from Actun Jih. These, taken November 12, were mother and young, the young nursing at the breast. The mammae are 1–0–0 = 2. Parasites removed from the nursing female were *Trichobius parasiticus* Gervais and *Euctenodes mirabilus* Waterhouse.

Myotis nigricans extremus Miller and Allen. Yocat, Actun Lara, 24; Parasites saved from this series were described as a new species, *Trichobius hirsutulus*, by Dr. Joseph Bequaert (Contribution to the Entomology of Yucatan. Chap. 29 in G. C. Shattuck's 'The Yucatan Peninsula', Carnegie Inst. Washington, 1933).

Rhogeëssa tumida H. Allen. Chichen Itza, 1. This specimen was captured in a butterfly net as it flew about after sundown.

Nasua narica yucatanica Allen. *Pisote.* Chichen Itza, 4. A young coati, kept captive for several days, willingly ate some nestling doves, live small lizards, and cooked fat pork scraps, but refused cold raw meats, bananas, oranges, pancakes, crackers and canned milk. An adult female measured 982 x 490 x 95 x 36 mm.

Grison canaster (Nelson). *Mayub* or *Champ. Rey de los Ardillas.* Chichen Itza, 1. This, the second recorded specimen of the species, was secured fresh from a native hunter. A caged individual was seen in the Parco Centenario at Merida. At Chichen the animal was known to few of the Indians but was named by one "the king of the squirrels". The specimen, a male, measured 565 x 140 x 85 x 10 mm.

Canis sp. *Lobo.* A 55-year old guide we had at Oxcutzcab averred that the lobo formerly lived in Yucatan, and he even had for it a Mayan name which I failed to transcribe. It is more probable that a coyote was referred to than a wolf.

Felis sp. *Tigre.* Although we did considerable night hunting, it was not our fortune to encounter any of the cats. Tracks of a jaguar were once found in the dry dust of a minor cave at Chichen, and the animals are not infrequently encountered in the less populated parts of the peninsula. One fine jaguar skin that I saw was secured by a Mayan who, according to accounts, killed it during a charge by one blow through the chest with his machete.

Sciurus yucatanensis yucatanensis (Allen). *Ardilla.* Chichen Itza, 6. All specimens were secured in the jungle. Another individual was seen but not taken among scattered trees at the Aguada Polol near Hunabchen. In 1896 the squirrels were abundant at Chichen, according to Dr. Chapman, but we found them uncommon and shy in 1929. A caretaker then at Chichen had been there 10 months without having seen any until we secured these few. The mammary formula is 2 — 0 — 2 = 8.

Heterogeomys hispidus yucatanensis Nelson and Goldman. *Tuza.* Chichen Itza, 1; Yokat, 1. The burrows of pocket gophers were abundant wherever soil was deep enough to dig in, but these animals were so much larger than pocket gophers of the United States, for which our traps were designed, that the animals usually either pulled out of them easily or dragged them away.

Heteromys gaumeri Allen and Chapman. *Ratón.* Chichen Itza, 11. Specimens were taken in trap lines scattered through the brushy jungle, in the milpas of the Indians, and in the bottom of a dry cenote. Practically every individual had the cheek pouches loaded with food, but the items, although saved, have not been identified. Two embryos were secured from a specimen taken October 26. The mammary formula is 1 — 0 — 2 = 6.

Reithrodontomys gracilis Allen and Chapman. Chichen Itza, 1. The single specimen secured was a juvenile that had the misfortune to enter the pocket of my hunting jacket.

Peromyscus yucatanicus yucatanicus Allen and Chapman. *Ratón.* Chichen Itza, 15. Specimens were secured in the dry forest in the bottom of the dry cenote of Chichen Itza, along the upper rim of the cenote of Xtolok, and in one of the buildings. The mammae are 0 — 0 — 2 = 4. Two embryos were taken from a female secured October 25.

Oryzomys rostratus yucatanensis (Merriam). Chichen Itza, 1. This specimen was secured near the rim of the cenote of Xtolok.

Ototylomys phyllotis phyllotis Merriam. *Ratón.* Chichen Itza, 6. Specimens were secured in the dry cenote, the edge of the cenote of Xtolok, in a Mayan ruin, and in a habitation. There is a presumption that the "house rats" taken and discarded by Dr. Chapman in 1896 at the edges of the Xtolok cenote were of this species. Two embryos were found in a female taken October 15, and two more in a specimen taken two days later. The mammae are 0 — 0 — 2 = 4.

Otonyctomys hatti Anthony. Chichen Itza, 2. These specimens, possibly a pair, were secured in the same trap on successive nights at the line between thatch and wall of the guest house of the Carnegie Institution at Chichen Itza. The female, taken October 26, had an enlarged uterus. The mammae are 0 — 0 — 2 = 4.

Mus musculus Linnaeus. Chichen Itza, 2. One specimen was secured in a dwelling, the other near a building.

Rattus rattus alexandrinus (Geoffroy). *Ratón.* Chichen Itza, 2. Both specimens were taken in a thatch-roofed dwelling. It is possible that they should be referred to *R. r. frugivorus* (Rafinesque), which they resemble in their ventral pelage. Inasmuch as the mammary formula (2 — 1 — 2 = 10) is that of *R. r. alexandrinus*, however, I must consider them to be the latter. Nine embryos were found in a female secured October 14.

Rattus rattus subsp. Chichen Itza, 2. These two specimens are intermediate in appearance between the black rat and the roof rat, and for this reason are not given subspecific assignment. Both were secured in a dwelling.

Sylvilagus sp. *Conejo.* One individual was seen at Yokat while I was night-hunting. It is well known to hunters.

Pecari angulatus yucatanensis (Merriam). *Quitam.* At Ticul, a full grown, although possibly young, collared peccary had the run of the streets and chased away domestic pigs of its own size. Presumably the animal was the property of one of the Indians resident in the town.

Mazama pandora Merriam. *Yuc, Venado.* Chichen Itza, 1. This specimen measured 1034 x 130 x 265 x 145 mm. Its weight was 42 pounds. The mammae are 0 — 0 — 2 = 4.

Odocoileus toltecus (Saussure). *Ceh, Venado.* Calcehtok, 1; Yokat, 2. A specimen secured November 10 at Yocat had apparently given birth to a fawn shortly before she was shot. Her measurements were 1400 x 190 x 350 x 180 mm. Although the collector of a few specimens encounters considerable legal difficulty with permits, there are, it is estimated, as many as 50,000 deer hides commercially exported from Progreso during a year. I personally saw papers executed for the export of one shipment of 1300 skins.

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RELATION OF SIZE OF POCKET GOPHERS TO SOIL AND ALTITUDE

By William B. Davis

While working out the distribution and taxonomy of pocket gophers in southern Idaho, I became interested in the problem of correlation of size with soil conditions and altitude. I do not claim to have settled a problem; in fact, I intend merely to point out one that, to me, warrants further study.

The specimens and field notes on which this discussion is based are contained in the Museum of Vertebrate Zoology, Berkeley, California. I wish to thank the officials of that museum for the many privileges extended me; also, to acknowledge the generous assistance of Messrs. David Johnson and D. Tillotson in supplying additional specimens and information.

Pocket gophers, especially the males, tend to increase in size with age. The ultimate size attained appears to be correlated directly with the type of soil inhabited, and indirectly with altitude. At high elevations where the soil usually is shallow and rocky, or at lower elevations where the same general environmental conditions prevail, races and individuals of the same species tend to be small. In places of this kind the skulls of males and females often are indistinguishable; they are smooth and lack ridges. They are juvenile in character and in many respects appear not to have developed beyond the subadult state of forms living under better environmental conditions. If one compare individuals from poorer soils (for pocket gophers) with others from progressively better and deeper ones, the size of both sexes is found generally to increase, males more so than females. Under optimum conditions the actual weight of the skulls may average two or even three times that of individuals that live amid adverse conditions. In the deeper soils sexual dimorphism is evident and the skulls of both sexes are angular in outline and have well developed sagittal, lambdoidal, and temporal ridges.

This general reduction in size at higher altitude is illustrated by specimens from near Pocatello, Idaho. There the species *Thomomys quadratus* occurs altitudinally from 4400 feet on the floor of Portneuf Valley to over 7000 feet in the Bannock Mountains. Individuals taken from the valley are considerably larger than those from higher altitudes. The skulls are massive, prognathous, angular, and ridged, the males much larger than the females. Individuals taken at progressively higher altitudes are smaller, the skulls tend to be less angular and ridged, as well as less prognathous, and the degree of sexual dimorphism is reduced. Taking the product of three dimensions of the skull, basilar length, zygomatic breadth, and palatofrontal depth, as an index of size, the following results were obtained:

	Males	*Females*	*Difference*
4500 feet	1295 (3)*	1035 (3)	260
5000 feet	1360 (4)	930 (3)	430
5800 feet	1060 (2)	880 (2)	180
6300 feet	920 (6)	840 (6)	80
7000 feet	920 (2)	850 (1)	70

* Number of specimens averaged.

Certain discrepancies are evident in the comparisons. Males from 5000 feet are larger than those from 4500 feet; the female from 7000 feet is larger than those from 6300 feet. These exceptions do not invalidate the general principle because age differences in the males and too few specimens in the females probably account for the deviations from the expected size. A reduction in length of body, length of hind foot, and length of tail accompanies a reduction in "volume" of the skull.

Similar results were obtained in a study of another species in another locality. *Thomomys bottae* occurs on the floor of Monitor Valley, Nevada, at an altitude of 6900 feet, and also on the adjacent Toquima Mountains, which rise to over 10,000 feet. Individuals taken at altitudes ranging from 9000 to 10,000 feet on the mountain are considerably smaller than those from the valley; specimens from Meadow Creek Canyon, at 8000 feet on the east side of the mountain, are intermediate in size. Sexual dimorphism is pronounced in specimens from the valley; it is slight in specimens from above 9000 feet. These facts are evident from the following tabulation.

	Males	*Females*	*Difference*
6900 feet	1775 (6)	1250 (6)	525
8000 feet	1320 (2)	1060 (2)	260
9000 to 10000 feet	1060 (5)	920 (2)	140

Similarly, specimens of *Thomomys bottae* taken at different elevations on Mt. Moriah in eastern Nevada and western Utah exhibit the same trend. Skulls of specimens from 5000 feet elevation are much larger than those from high on the mountain. Between the two extremes the skulls are intermediate, grading, as evidenced below, from large, with pronounced sexual dimorphism, at the bottom, to small at the top, with little difference between males and females.

	Males	*Females*	*Difference*
5000 feet	1664 (3)	1221 (5)	443
5400 feet	1268 (2)	1085 (3)	183
6000 feet	1177 (2)	—	—
6700 feet	—	1001 (2)	—
9100 feet	1139 (3)	994 (6)	45
9800 feet	1086 (1)	1009 (1)	77
11400 feet	—	971 (2)	—

Again, certain discrepancies appear, but the gradation is clearly evident. Aside from consistently smaller size, specimens of both *quadratus* and *bottae* from the higher altitudes are but little different from those at low levels. The most significant difference is found in the relatively shorter rostrum in specimens from high altitudes. This I interpret as an expression of arrested development. Numerous studies have shown that the rostrum in subadult pocket gophers is consistently relatively, as well as actually, shorter than in adults.

Gradation from large to small size is found in every area studied in the Great Basin where *one species occupies both the valley floor and the adjacent mountain*. Because of this, it becomes increasingly difficult to reconcile present practices in taxonomy with the situation as it actually exists. The tendency of certain students to assign all the populations of pocket gophers occurring on different, isolated mountain tops to one subspecies and those occurring in the lowlands to another defeats the purpose of systematics. To me, it is illogical to assume that the several alpine populations are closely related *inter se* and genetically different, as a unit, from the populations of the same species occurring in the valleys. Nor does it seem logical to assume that the populations of a species in two valleys, separated by a high mountain range on which small individuals of the same species occur, are genetically related *inter se* and at the same time genetically distinct from the smaller alpine individuals.

Various authors have referred the alpine populations of pocket gophers in southern Idaho to *Thomomys uinta* or *Thomomys quadratus uinta* and those in the lowlands to *Thomomys bridgeri* or *Thomomys quadratus bridgeri*. In doing this the topography and geologic history of the area probably were not considered. In this region the mountains certainly are older than the genus *Thomomys* and consequently we cannot assume that populations now restricted to alpine areas once occupied a continuous range that subsequently was disrupted by geologic changes. Nor can we assume that the population of large pocket gophers moved in and usurped the lowland portions of a range once occupied by the smaller animals. Such an assumption would necessitate a divergence of the two at a time earlier than that suggested by cranial characters. Furthermore, it would necessitate a migration of the large individuals *over* high passes in order to explain their present distribution in southern Idaho.

In interpreting the past history of *Thomomys quadratus* in southeastern Idaho I have assumed that during the Pleistocene most of the mountains were glaciated and the lower valleys under water, so that intermediate altitudes alone were available to pocket gophers. It is well known that the yearly increase of a successful species is greater than the carrying capacity of the area occupied, and that as a result of population pressure every available niche is sought out and occupied. As the glaciers receded and the lakes decreased in extent, additional territory became available both above and

below the former range. This new territory was occupied by the surplus of the yearly increase. Those gophers that moved down hill encountered deeper and richer soils and consequently could grow larger without handicap. Those that moved uphill found conditions progressively more adverse; the soil was shallower and rockier and plant food less abundant, although sufficient to maintain life. Only individuals with small bodies could survive amid such conditions. Whether size *per se* be heritable or due to ontogenetic processes is not of prime importance to the question at issue because the end result—size—in either instance is the limiting factor in shallow soil. Ultimately, from a population of pocket gophers of medium size, both the mountains and the lowlands became populated, the former by small individuals, the latter by large ones. The parent stock probably remained at intermediate levels.

Such an interpretation explains many facts of distribution. Each high mountain in southern Idaho harbors a population of dwarfed individuals, in each valley the gophers are large, and at middle altitudes, of intermediate size. The alpine populations, even on isolated mountain tops, resemble one another more than they do those in the valleys, yet it is difficult to conceive of them as being subspecifically related *inter se* and at the same time subspecifically distinct from those at lower elevations. The similar cranial characters of the two extremes, the gradation from large size to small, and the topography and geologic history of the region, point toward the conclusion that the alpine and lowland forms are of the same subspecies. This applies also to the two localities in Nevada whence specimens were examined.

The only other logical method I see of treating these alpine populations is to *name each one of them*, a practice that would lead to confusion and ridicule, yet one that is followed by some students.

We should be more cautious in our designation of new races. All too little attention has been given to the study of the effect of environment upon the size of animals. If environmental conditions produce a condition of arrested development, should animals exhibiting this condition be recognized by name? Whether pocket gophers from alpine areas would increase in size if transplanted to better soil at lower elevations, or whether they would retain their identity, is not known. An experiment designed to test this point would be well worth while.

SUMMARY

1. In each of three localities in southern Idaho and the Great Basin where *the same species* of pocket gopher inhabits both the lowlands and the adjacent mountain, a gradation from large, sexually dimorphic individuals, at lower elevations where the soil is deeper, to small individuals with little, if any, sexual dimorphism, at higher elevations where the soil is shallower, is exhibited.

2. Since the same trend occurs at each of three widely separated localities,

it seems logical to conclude that the gradient is a true one; also that the populations at the two extremes of such a gradient are not worthy of recognition by separate names.

3. The possibility of this gradient occurring in other localities should merit careful consideration in systematic work with *Thomomys* so that the formal naming of populations not worthy of recognition by name will be avoided.

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SEXUAL PHOTOPERIODICITY OF RACCOONS ON LOW PROTEIN DIET AND SECOND LITTERS IN THE SAME BREEDING SEASON

By Thomas Hume Bissonnette and Albert G. Csech

A previous study of sexual photoperiodicity of raccoons (*Procyon lotor*) showed that on complete and adequate diet with proteins built up with fresh meat and fish to 40 per cent or more, by weight, fertile matings from animals of good breeding capacity could be obtained in December instead of February by increasing night-lighting in autumn (Bissonnette and Csech, 1937). Litters were of the same numbers as on the preceding normal light-cycle and were reared successfully in outdoor pens with dens through severe winter weather without supplementary heating. Females whose breeding capacity was low or zero in previous years on normal light cycles, when mated with the same males as were bred to females having litters, either became pseudopregnant or failed to ovulate. On the same diets, but without experimental lighting in autumn, controls bred at the usual time in February and gave the same variation from no litters to those of 1 to 6 young ones per litter. No experimental female deserted her young and all suckled and weaned them. Among controls, a very few failed to care for or to suckle some or all of their young ones. On being returned to the same males after pseudopregnancy or after suckling young, several of the experimental females were seen to mate a second time, but no litters resulted from this second mating period.

The number of experimental animals was small (6 ♀ ♀ + 3 ♂ ♂); but the results seemed very promising for obtaining litters from early-born young in their first winter season. It also seemed that if experimental lighting was stopped after first mating periods, perhaps second litters in the same season might be obtained from some or all of the experimental females. This would greatly increase production as well as cut the cost of producing

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raccoons for re-stocking areas for hunting, and of selection of a prolific strain of animals with fur superior in color, length and density.

Similar pens containing one or two females with a single male were wired as before for experimental lighting (Bissonnette and Csech, 1937), to continue the experiment on a larger scale. Owing to a misunderstanding with the company supplying the "balanced and complete ration" for raccoons, leading us to understand that the ration was complete for these animals at all times, including breeding and lactation, no such build-up of proteins with meats as that of the previous experiment was made until the paucity of the litters produced led us to seek a possible cause in the quality of the food used.

Materials and methods.—Thirteen pairs of controls (1♂ + 1♀), one of which consisted of young individuals born as the result of December matings, were selected from the colony. Some were of known breeding capacity; others were young ones that had not yet bred. Known non-breeders were eliminated.

Thirteen pens, 9 with one female, and 4 with two females per male, housed experimental animals whose breeding histories were similar to those of controls. One pair of these was early-born, from December matings.

Pens for controls and experimentals were alike and all in the same grove. Food was adequate in amount and the animals grew fat upon it. But, whereas the protein in the previous experiment was built up to between 40 and 50 per cent of dry weight, the "balanced complete ration" in these experiments tested only 21.19 per cent protein. Except for this difference in protein content, and slight change in lighting schedule, these experiments were exactly like those of the previous year.

Experimental pens were lighted for one and one-half hours per night from October 19, for 3 hours from October 29, and the lighting period each night was then increased by one hour each 10 days to 8 hours per night on December 18, with no increase thereafter. When females became savage near term and were isolated, experimental lighting was discontinued and not resumed thereafter, because in the previous experiments its continuance was found to be unnecessary for successful lactation.

As soon as lower productivity became evident on the so-called "complete and adequate ration," meat and fish were added for all animals as in previous years. This was before the latest experimentals had their young, and when controls were approximately half through gestation or pseudopregnancy.

After the gestation period was over, and after suckling by females having litters, all experimental females were returned to the males with which they had previously been mated, but without experimental lighting. Some were seen to mate again, some were not, but we suspect that most of them did. All had the higher protein diet built up with meat and fish.

Observations and results of first matings.—Both control and experimental animals reduced their food consumption during late November and December, but only a few of the controls stopped eating and "holed up." This was probably due to the mildness of the weather and lack of deep snow. None of the experimentally lighted animals "holed up" or stopped eating.

On December 15 and 17, an experimental female that had had 4 young from December matings during the previous year, was seen to mate. While not all of the experimentals or controls were seen to mate, many were observed to do so, including both young pairs born early in the previous winter, and the behavior of all leads us to believe that all of them did mate. One experimental pair was seen to mate as late as January 5. Controls did not begin mating until the usual time in February.

Some females among both controls and experimentals became vicious before term; others did not. Some of both built nests but had no young; others did not; and not all females that bore young built nests. The black raccoons at this sanctuary seldom build nests and several of the pairs used were either black or hybrid black. Some may have been pseudopregnant; others may not have ovulated, as the result of infertile matings. This point needs further study.

Although both control and experimental early-born young pairs mated when the others in their groups did so, neither had a litter. These infertile matings also occur in their first winter with animals born at normal times. So it is not significant as indicating increased or early breeding capacity. Among the 2 males and 3 females of the same litter in an exhibition pen at the sanctuary, born at normal time in the previous spring, but not used in these experiments, two females became pregnant and had litters of two each on May 16 and 18 (late). One cared for one young and killed one; the other abandoned both its young ones when they were moved to breeding pens. Pregnancy in the first winter occurs very rarely and in this case was not due to experimental lighting. These animals, however, had no darkened dens like those of experimental and control animals. They did, therefore, get more light by day during autumn and spring than the ones used in this study. This extra light may account for their breeding.

Table I gives results for all animals that cast litters. Three out of 13 control pens, 6 out of 13 experimental, and, in one case, 2 females from the same pen, produced litters on March 13 and 19, respectively, or 7 experimental females out of 17. The latest "experimental" litter was 29 days earlier than the earliest one of the "controls," and the earliest experimental litter 48 days before the earliest control litter.

Table II gives records of performance of those females whose records cover 1935, without lights and on higher protein diet, 1936 both with and without lights on high protein diet, and 1936–1937 with and without lights but on "low" protein diet during early part of the experiment until earliest gestations were complete.

Three females that had early litters from experimental lighting during the previous winter's experiments (Bissonnette and Csech, 1937) were again lighted this winter. One had a litter of 3 as in two previous years; but deserted them this year. The other 2 that had 4 and 1, respectively, in each of two previous seasons, one under experimental lighting and one not, failed to become pregnant this season. All 3 became vicious toward the end of gestation, but the 2 non-pregnant animals ceased to be vicious before term.

TABLE I

RESULTS OF BREEDING

PEN NO.	DATE OF LITTER	NO. OF YOUNG	NO. CARED FOR	NO. ABANDONED	DEN OPENED FOR INSPECTION
		Controls			
1	Apr. 17	4	4	0	no
2	Apr. 19	2 (1 still born) (had only 1 year before)	0	2	yes
3	May 15	3	3	0	yes
		9	7	2	
	3 pens out of 13 gave litters. 3♀♀ out of 13 = 23+%				
		Experimentals			
1	Feb. 28	5	4	1	yes
2	Mar. 3	3	0	3	no*
3	Mar. 6	4	4	0	yes
4	Mar. 7	4	4	0	yes
5	Mar. 9	5	5	0	yes
6	Mar. 13	4	0	2 & ate 2	yes
7	Mar. 19	3	3	0	yes
		28	20	8	
	6 pens out of 13 gave litters. 7♀♀ out of 17 = 41%				

* Three young ones abandoned on March 6 and chilled stiff were taken to the house in the forenoon and revived. One lived until late afternoon and one for 3 days before dying. This female had had 3 young in 1935 without lights and reared them. This year, on light, she had 3 and abandoned all of them.

Litters from second matings of experimental animals.—Four females had litters from the second mating period after return to males. Of these some were seen to mate, while some were not. This leads us to believe that most, if not all, of the females returned to the males mated again. None had any experimental lighting at this time. Of these 4, 3 had litters from the first matings and the fourth, having 5 kits, had not become pregnant as the result of the first matings earlier in this season.

Discussion and conclusions.—On this year's low protein diet, but under conditions otherwise similar to, or more favorable than, the preceding year, controls gave fewer pregnancies (23%) than normal in nature and than on the higher protein diet of the previous years in this colony (25% for 1935 and 40% for 1936). Experimentals gave a higher than normal number of pregnancies in both 1936 (50%) and in 1937 (41%), but the 1937 rate was lower

TABLE II

PERFORMANCE OF FEMALES WHOSE RECORDS COVER 1935, 1936 (HIGH PROTEIN) AND 1937—1 (ON LOW PROTEIN DIET), 1937—2 (ON HIGH PROTEIN DIET)

	ANIMALS											
	a	b	c	d	e	f	g	h	i	j	k	l
1935	(2 − 1)	(0)	(5 − 1)	(1)	(4)	(1)	(3) + 17 (0) = 6 out of 24—25%					
1936	(1)	(4)	(4)	(1)	(4L)	(1L)	(3L)	(0)	(1)	(6)	(3)	(0)
1937—1	(3L)	(0L)	(5L − 1)	(0L)	(0L)	(0L)	(3L − 3)	(0)	(2 − 1)	(0L)	(0L)	(4L − 2E − 2)
1937—2	(1)									(5)		

	ANIMALS	
	m	n
1936	(4)	(0) + 9(0) → 3 out of 6 light (50%) and 8 out of 20 controls (40%)
1937—1	(4L − 1)	(0L) + 3(0L) → 7 out of 17 on light (41%) and 3 out of 13 controls (23%)
1937—2	(3)	

Numbers in parenthesis indicate number of animals in litter without experimental lighting.
L indicates those with experimental lighting.
E indicates those eaten.
Minus number indicates those deserted. e.g. (2 − 1) means two born, one deserted.

TABLE III

BREEDING RECORDS OF LIGHTED FEMALES HAVING LITTERS FROM SECOND MATING PERIOD IN 1936-37 SEASON

YEAR	♀a	♀j	♀m	♀o
1935	(2 − 1)	—	—	—
1936	(1)	(6)	(4)	—
1937, no. 1	(3L) Mar. 19	(0L)	(4L − 1) Feb. 28	(4L) Mar. 6
1937, no. 2	(1) Aug. 12	(5) July 27	(3) Aug. 13	(1 − 1) Aug. 18

than that of 1936 in spite of the fact that known non-breeders of two years had been eliminated, and weather was milder this winter than last.

When litters did occur among artificially lighted animals they averaged somewhat larger than in the previous experiment (4 this year: 2.6 last year) and than among controls both last year and this (4 this year: 3 last year). Baker and Ranson (1932) found that with field mice, winter type of food was better for reproduction and gave more young than summer type, with its smaller amount of proteins and fewer seeds, but more fresh or green food.

The milder weather with less heavy snow this year may account for the failure of several control animals to stop eating and "hole up." All controls, but none of the artificially lighted animals, had ceased to eat and "holed up" during December and January of last year's experiment (Bissonnette and Csech, 1937).

The tendency for females to abandon young ones is not peculiar to these conditions but occurs in nature. It was, perhaps, more frequent this year than formerly. The eating of some young occurred among controls both last year and this, as well as among experimental animals this year. Last year on the higher protein diet one control female ate her young at 6 weeks of age. So this behavior was not caused by disturbing the animals immediately after parturition nor entirely by the low protein diet. It occurred this year in some cases when the den was not even opened, and did not occur in some that were frequently looked at and even moved about. No definite conclusions regarding the reasons for abandoning and eating young ones can be drawn from these experiments. It seems to depend on the disposition of the female at the time, and is not even characteristic of a given female in different years. The same female may do it one year and not the next.

If the small numbers of animals may be taken as representative, it appears that, with unfavorable diet, those subjected to experimental lighting were not so adversely affected by the lack of proteins as those on normal light cycles, so far as reproduction is concerned. But this, too, needs further study. It does appear, however, that the experimental lighting and forcing of sexual activation in early winter does not lessen reproductive effectiveness and it obviously offers the advantage to the young that they get a longer period of favorable weather and daylight in the spring and summer of their first year, after they are weaned and leave the den to forage for themselves.

The litters produced from the second mating periods and born between July 28 and August 18 are evidence of increased breeding capacity of these animals, if first matings can be induced earlier in winter. The second matings after pseudopregnancy and after suckling did not occur among controls nor in nature. Such matings occurred in the first set of experiments (Bissonnette and Csech, 1937); but no pregnancies resulted. The litters born from these second matings were all suckled properly except one born on August 18 and at once deserted. All the others lived well and were weaned normally. They will doubtless be large enough to be liberated next spring.

The young from the early matings were sufficiently grown in August and all were liberated then. This reduced the cost of producing young raccoons for liberation to a little more than one-half that required for those born at normal times, for they usually have to be carried over the first winter before being sufficiently grown for success in the wild. When this saving is added to that resulting from second litters in the same season, from even a few females, the total is quite considerable.

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DISTRIBUTION OF MARMOTA MONAX IN THE MISSOURI VALLEY REGION

BY MYRON H. SWENK

In his Revision of the American Marmots, A. H. Howell (North Amer. Fauna, no. 37, pp. 1–80, 1915) recognized three subspecies of the dark-footed woodchuck (*Marmota monax*) from the Missouri Valley region. In the preparation of this revision he studied specimens of *M. m. canadensis* (Erxleben) from Pembina, Pembina County, North Dakota, and Tower, St. Louis County, Two Harbors, Lake County, and Aitkin, Aitkin County, Minnesota; of *M. m. rufescens* Howell from Grafton, Walsh County, and Fargo and Leonard, Cass County, North Dakota, and Princeton, Millelacs County, Elk River, Sherburne County (the type locality), and Fort Snelling, Hennepin County, Minnesota; and of *M. m. monax* (Linnaeus) from Johnson and Sac counties, Iowa, Marble Cave, Missouri, and Douglas County, Kansas. Since 1915, other mammalogists have contributed data that have helped to outline in somewhat greater detail the ranges of these three subspecies of *Marmota monax* in the Missouri Valley states; and one new subspecies has been described from this area.

Vernon Bailey (North Amer. Fauna, no. 49, pp. 67–70, 1926) recorded the form *canadensis* from Walhalla, Pembina County, and *rufescens* from Devils Lake, Ramsey County, Stump Lake, Nelson County, Larimore and Manvel, Grand Forks County, and Wahpeton, Richland County, North Dakota. C. E. Johnson (Jour. Mamm., vol. 4, p. 105, 1923; vol. 11, p. 444, 1930) recorded woodchucks as absent in Marshall County, northwestern Minnesota, but present (undoubtedly *canadensis*) around Thief River Falls, Pennington County, and in parts of Koochiching and Itasca counties and northern Lake County, in that state. A. R. Cahn (Jour. Mamm., vol. 2, p. 72, 1921) recorded *canadensis* as a common mammal throughout Itasca County. Bernard Bailey (Jour. Mamm., vol. 10, p. 158, 1929) recorded *rufescens* as then rare in localities in Sherburne County, Minnesota, where it formerly had been common. Thaddeus Surber (Mammals of Minnesota,

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pp. 56–58, 1932) has summarized the status of the Minnesota subspecies by recording *canadensis* as common in Cook and Lake counties, and less common in St. Louis, Koochiching and Lake of the Woods counties, northern Minnesota, intergrading with *rufescens* from the latitude of Itasca County southward, and the latter in turn intergrading with typical *monax* near the Iowa border. Dayton Stoner (Rodents of Iowa, pp. 45–50, 1918) recorded *M. m. monax* from Allamakee, Winneshiek, Clayton, Fayette, Dubuque, Delaware, and Buchanan counties, in the northeastern corner of Iowa; from Henry, Wapello, and Davis counties in southeastern Iowa, from Dickinson, Clay, and Palo Alto counties in west north-central Iowa, and from Dallas, Clarke, and Union counties in west south-central Iowa. He stated that this mammal is common in eastern Iowa, but is seldom seen in the western part of the state.

In his 1915 revision, Howell referred especially to the series of 9 specimens before him from Lawrence, Douglas County, Kansas (p. 24) which he identified as *M. m. monax*, stating that this series seemed to indicate the presence there of a large form characterized by longer hind feet and larger skulls, especially of the females, and indicated that additional material from that region might require the naming of this form. In the next 20 years the Museum of Birds and Mammals of the University of Kansas increased the series of woodchucks available for study from the vicinity of Lawrence and elsewhere in Kansas to 61 specimens, and a recent scrutiny of this augmented series by J. D. Black (Jour. Mamm., vol. 16, pp. 318–320, 1935) corroborated the preliminary findings of Howell, as well as bringing out some additional slight external and cranial differences in the Kansas series, as compared to specimens of typical *monax* from farther east, so that the Kansas woodchuck was differentiated as a new subspecies, under the name *M. m. bunkeri*. In his diagnosis of *bunkeri*, Black definitely recorded it from Douglas, Franklin, Leavenworth, Atchison, and Doniphan counties, in northeastern Kansas, and expressed the belief that the animal occurs along the streams of northeastern Kansas westward for an undertermined distance. D. E. Lantz (Bull, no. 129, Kansas Agric. Exper. Sta., p. 353, 1904) had previously stated that the woodchuck was confined to the rolling parts of the northeastern and eastern counties of Kansas, and had not been reported west of the Big Blue River. L. R. Dice (Jour. Mamm., vol. 4, pp. 107–112, 1923) did not include it among the mammals known to occur in Riley County, Kansas, which lies just west of that stream. Black further stated that *bunkeri* had a range "probably extending north into Nebraska" (p. 319), a conjecture that has proved to be correct.

After the appearance of Howell's revision, the writer attempted the accumulation of speciemens of woodchucks from Nebraska, as well as data on the range of the mammal in that state. A study of the information thus secured indicates the validity of *M. m. bunkeri* Black as a recognizably differentiated subspecies. It also shows that this species has gradually been extending

its range in southeastern Nebraska, especially during the past 20 years. Apparently *Marmota monax* was originally confined in Nebraska to the bottomlands of the Missouri River, from about the mouth of the Platte River southward, and was decidedly uncommon even there. The first record of its occurrence in the state is that of Thomas Say (Explor. to Rocky Mts. under Major Long, 1823), who reported the "Maryland Marmot, *Arctomys monax*" as among the mammals observed by him between September 19, 1819, and June 5, 1820, at Engineer Cantonment, which was the official name given to the camp of the Long Expedition, and was located on the west bank of the Missouri, at old Fort Lisa, near the Council Bluff of Lewis and Clark (now Fort Calhoun) in southeastern Washington County, just above the Washington-Douglas county line, and about 10 miles north of the present city limits of Omaha, Douglas County. The late Lawrence Bruner stated to the writer in 1906 that during his 50 years residence in Nebraska he knew of but one locality in the state where woodchucks had been repeatedly seen and killed, and that was along the Missouri River in the vicinity of Peru, Nemaha County.

A tendency toward the increase and spread by this species in southeastern Nebraska was first noted about 1916. In April of that year, Glen Smith killed a male woodchuck (no. 2643, A. M. Brooking collection) near Fairbury, Jefferson County. This specimen apparently was slightly subadult, its total length (in the flesh) and its tail vertebrae having been rather short, but nevertheless, its hind foot measured 89 mm., which is as large or larger than that of fully adult males of typical *monax* from Maryland and Virginia (Howell, 1915, p. 24), thus bearing out the characters of *bunkeri*. On May 14, 1916, a specimen was killed on the farm of C. B. Barkhurst, northeast of Weeping Water, Cass County, the animal having been chased by a dog about 10 feet up into a walnut tree, where it was shot and killed. Barkhurst stated that he had heard woodchucks on his farm since 1911 or 1912, but never had actually seen one of the animals until this one was treed and shot. The skull of this specimen indicates a somewhat small but fully adult animal, its measurements being rather intermediate between the averages of 6 specimens of typical *monax* from the East and 11 of *bunkeri* from Douglas County, Kansas, agreeing best with the first-mentioned series in the length of the maxillary tooth row (only 20.5 mm.), but otherwise with *bunkeri* in the general larger size, especially the longer nasals and greater breadth of rostrum.

About 1919, the writer learned that there were a few woodchucks in north-central Richardson County in the vicinity of Stella, and made arrangements to secure one. G. W. Lambert trapped a fine adult male on February 12, 1920. This specimen, like the one from Fairbury, presented total length and tail measurements even less than old adult specimens of typical *monax* from Maryland and Virginia, and also rather less in total length than the smallest specimens of *bunkeri* from the type locality, but the long hind foot

(93 mm.), as well as the cranial characters, indicates its closest affinity with *bunkeri*, the skull measurements in general being about the maximum for that subspecies and exceeding even the maximum exhibited in the 11 topotypes of *bunkeri* in the length of the maxillary tooth row (23.7 mm.). This specimen weighed 9 pounds.

By 1922 woodchucks had become sufficiently numerous in Richardson County to be something of an economic problem. J. L. Worrell, then Richardson County Agricultural Agent, on June 29 of that year reported that these animals were becoming very plentiful, and that he had received numerous enquiries from farmers as to how to control them. Woodchucks continued to increase in Richardson County for about the next 7 years, and on June 1, 1929, County Engineer B. C. Dale reported that in places control measures were still necessary against them. In the fall of 1936, O. S. Bare, Extension Entomologist of the Agricultural College, twice observed woodchucks along an osage orange hedge 2 miles south and 3 miles west of Falls City, locating several of their burrows along this hedge, and also on the same day he located other burrows of these animals in some timber along a creek 2 miles southwest of Salem.

The same condition that had developed in Richardson County by 1922 apparently also obtained in Nemaha County (the next county to the north) by 1925, for on June 4 of that year J. B. Titus of Auburn wrote for information as to the best way to control these animals. In April, 1937, O. S. Bare found woodchucks burrowing and doing considerable damage to a log and earth dam 2 miles west and 3 miles south of Brownville, and on the same day observed two woodchucks 5 miles east and 2 miles north of Auburn, and located their burrows along an osage orange hedge.

Also by 1925 woodchucks apparently had followed the Platte River bottom for the length of Sarpy County, and thence northwestward into eastern Saunders County, for on November 30 of that year County Agricultural Agent R. N. Houser of Wahoo reported serious damage in a sweet clover field and on bluegrass pasture ground on a farm near Mead, and enquired as to methods of control. On November 9, 1937, a large adult male woodchuck was found dead near Ashland, Saunders County, and subsequently was sent to Ralph Velich of Omaha, who preserved it as a skin. Its upper incisors had become completely broken off at their bases, thus preventing the animal from eating, and it apparently had starved to death. This woodchuck was of large size, with the hind foot 98 mm. long, and obviously is also referable to subspecies *bunkeri*.

By 1936 woodchucks had become something of an agricultural pest in Pawnee County, the next county west of Richardson, just as they had 10 or 15 years earlier in Richardson and Nemaha counties. On May 28 of that year, Loyal J. Miller, Pawnee County Agricultural Agent, reported this condition, and requested information on woodchuck control. In the spring

of 1937, O. S. Bare located several woodchuck borrows along a wooded creek tributary to the Nemaha River one-fourth mile south of Table Rock. While he did not see any of the animals, a farmer informed him that they were

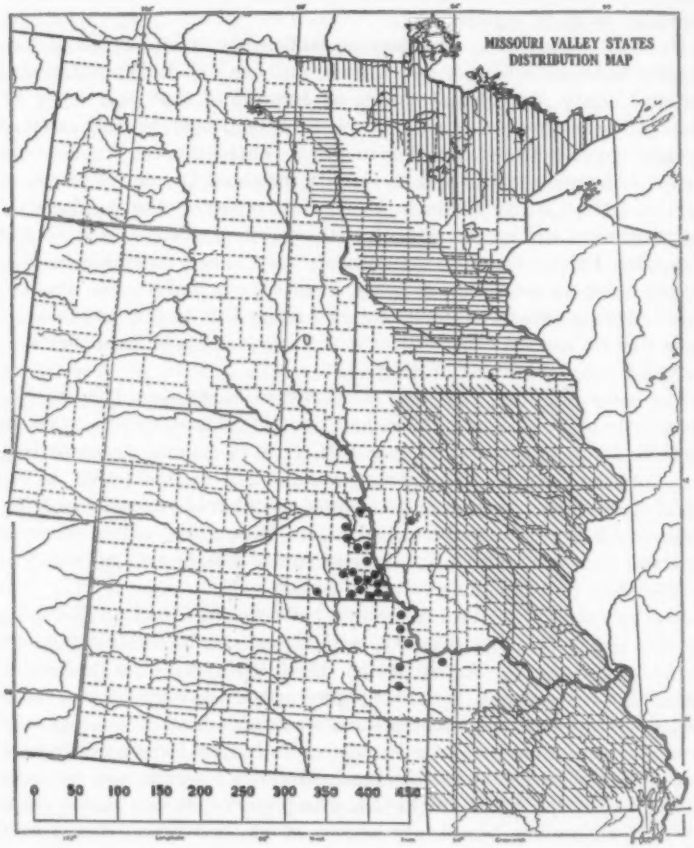

FIG. 1. Distribution of the Missouri Valley subspecies of *Marmota monax*. Vertically lined area indicates the known distribution of *M. m. canadensis*, horizontally lined area that of *M. m. rufescens*, diagonally lined area that of *M. m. monax*, and dots the known localities of record of *M. m. bunkeri*.

numerous there, and that in recent years they had done considerable damage to crops. Recently, J. B. Douglas of the Nebraska Game, Forestation and Parks Commission informed Mr. Bare that woodchucks were not uncommon

in the neighborhood of Elk Creek and Tecumseh, Johnson County, and that specimens had been caught near Tecumseh. Mr. Bare has also received reports from farmers in Otoe and Cass counties that woodchucks are now common in the eastern parts of these counties. One farmer stated that they were numerous a few miles south of Plattsmouth, Cass County.

By 1931 woodchucks had extended northwestward along the Greater Nemaha River through Pawnee and Johnson counties to the headwaters of the stream in northern Gage County, as is attested by the finding by W. C. Montgomery of a dead specimen, apparently a female, that had been shot on June 15 near Cortland, Gage County. The skin of this specimen was preserved by W. E. Beed for the Department of Zoology collection of the University (no. 80), but the skull could not be saved. This individual was greater than average *bunkeri* in total length and length of hind foot, but, like the other Nebraska specimens examined, seemed shorter-tailed than the average.

It seems very probable that the woodchucks of northwestern Missouri are *M. m. bunkeri*. In fact, in the table of measurements of woodchucks given by Baird (Explor. and Surv. for a R. R. Route to the Pacific Ocean, vol. 8, p. 343, 1857), the specimen from "Western Missouri" collected in June, 1854, by Dr. P. R. Hoy (Cat. no. 347, skin no. 1261, U. S. N. M.) is conspicuous for the large size of its skull as compared with the measurements of 12 specimens of undoubted *M. m. monax* from Massachusetts, New York, Pennsylvania, Wisconsin, and Illinois, and very probably represents *M. m. bunkeri*. The specimen probably was taken in or near Jackson County, Missouri. Another specimen recorded from "Western Missouri" (skull no. 3326, U. S. N. M.), collected by Dr. J. G. Cooper, does not have its measurements given, but adds to the evidence that woodchucks were probably not uncommon in the valley of the lower Missouri River in the region of the Great Bend during the 1850's, and the spread of the species over northeastern Kansas and southeastern Nebraska may have had its origin in the woodchuck population of this river valley area. But the woodchucks of southwestern Missouri are evidently *M. m. monax*. Black (*loc. cit.*, p. 320) indicated that specimens from McDonald and Stone counties in that part of the state are typical of *M. m. monax*.

It is also probable that the woodchucks of southwestern Iowa are referable to *M. m. bunkeri*, but the writer has examined no specimens from that section of the state. Stoner (*loc cit.*, p. 46) quoted F. C. Pellett as stating that between 1888 and 1918 he had known of 4 occurrences of this mammal in Cass County, and it would be interesting to know the subspecific identity of these specimens.

Lincoln, Nebraska.

NOTES ON THE OSTEOLOGY OF A BEAKED WHALE

By Malcolm Rutherford Thorpe

On November 19, 1937, a whale became stranded on Mason Island, off Mystic, Connecticut. The discoverer and donor of the specimen, Mr. Gourdan S. Allyn, of Mystic, notified the Yale Peabody Museum, and F. C. Herpich, W. J. Pagel, and V. R. Short, members of the staff, went to the island to collect the specimen.

So far as known, the whale was not seen in Long Island Sound before it was stranded on the island at ebb tide. The body had but one flesh wound, seemingly received in thrashing against a bulkhead on the island in its efforts to get back into deep water. After maceration it was discovered that the tenth rib on the left side and seventh dorsal and fifth lumbar neural spines had recently been broken, but what had produced these fractures could not be determined, unless it was the same cause as that which was apparently responsible for the broken rib.

The skeleton has been skillfully prepared under the careful supervision of Mr. Herpich, who has been of much assistance in the study of the specimen. The result of the study shows that the whale is an example of *Mesoplodon mirus* True, and, so far as I can determine, it is the fourth specimen of this genus and species that has been collected on the Atlantic Coast of the United States. The type came from Beaufort Harbor, North Carolina, in 1912; another specimen from Wells Beach, Maine, in 1906; and the third from Rockaway Beach, south shore of Long Island, New York. All of these, except the one from Wells Beach, are specimens of females.

Since the Yale specimen is a complete skeleton, it affords more data than does the holotype (no. 175019 U. S. N. M.) and it differs in some respects from the Rockaway Beach specimen (no. 90053 A. M. N. H.). It therefore may be considered as a plesiotype (no. 02430 Y. P. M.).

True (1913a and 1913b) described and figured in detail the skull and jaws of the type, and Raven (1937) has amplified this description on the basis of the American Museum specimen. I am able to add more data and for the most part have noted only those items in which the present specimen departs from those previously described. In all major structures the three females are remarkably alike, except that the Yale specimen is slightly smaller than the other two. This difference in size may be attributed to the fact that the other two are fully adult, while the Yale specimen was just reaching the adult stage. The total length of the National Museum and American Museum specimens was 16 feet in each case, while the latest example was 15 feet, 6 inches.

The species, *M. mirus*, was at once indicated by the position of the single pair of small teeth in the anterior extremity of the rami. In some characters the skeleton of this species resembles that of *M. europaeus* (Gervais) more

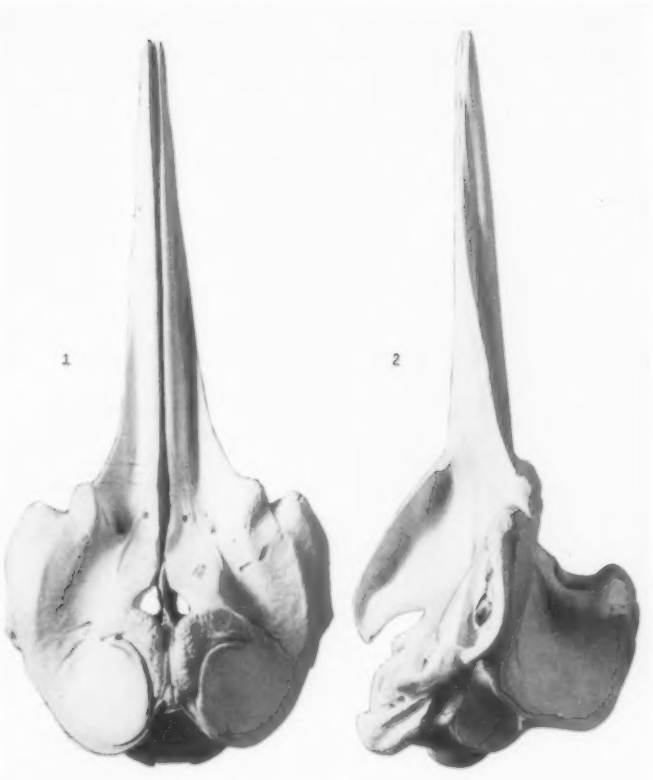

PLATE 1

Fig. 1. Dorsal aspect of the skull of *Mesoplodon mirus*. Fig. 2. Left lateral aspect of the same skull.

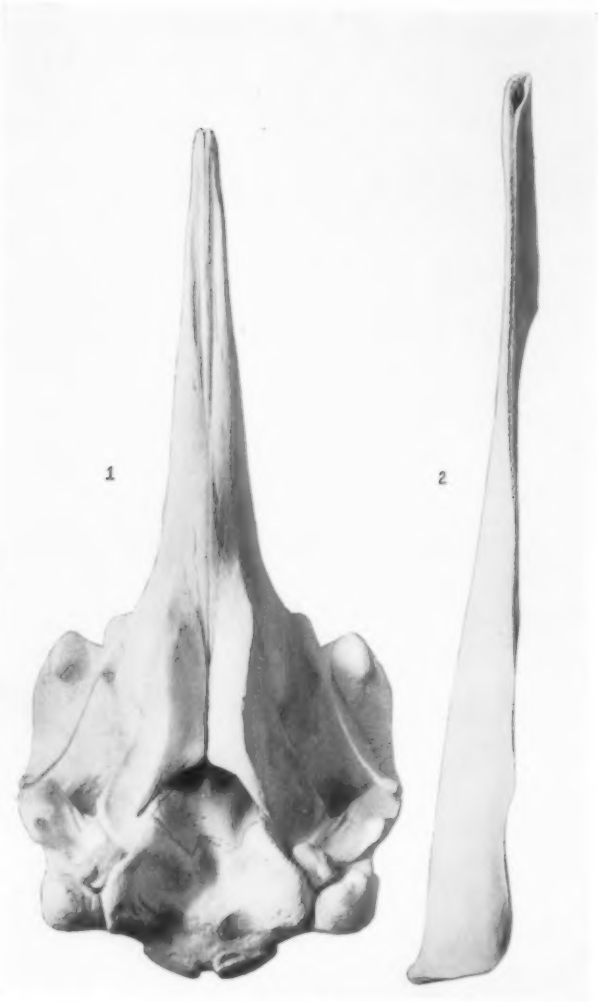

PLATE 2

Fig. 1. Ventral aspect of the skull of *Mesoplodon mirus*. Fig. 2. Dorsal aspect of the left mandibular ramus of the same individual.

closely than that of any other species, and I have had this in mind in making these notes.

Skull.—(Plates 1–2) The apex of the supraoccipital is obliquely truncated for a distance of 20 mm., hence it is less rounded than in the type. The anterior termination of the left frontal is in advance of that of the right.

The asymmetry of the skull is marked, so much so that the right premaxillary and nasal bone are about 30 per cent wider than the left, and the nasal septum is somewhat more asymmetrical than in the holotype.

The malar is a very slim bone but expanded at both ends. The anterior end is much the larger and is firmly locked between the maxillary, palatine, lacrimal. The posterior end is suturally articulated with the zygomatic bone.

The mandibular symphysis extends upward at a slight angle from the line of the jaw. The symphysial angle is well marked but gently rounded. The condyle is gently convex vertically but only slightly so horizontally. The angle is small, slightly rounded, and projects about 11 mm. beyond the line of the condyle. The coronoid is poorly defined and not clearly delimited.

Teeth.—(Plate 3, fig. 1) The two mandibular teeth are very small, compressed, sharply pointed, and partially procumbent in position. They did not penetrate the gums and were freed only by maceration. They are slightly curved and in lateral outline are triangular, with a maximum length of 34 mm. and a maximum breadth of 17 mm., thus apparently being slightly larger than those of the type. The distance from the alveolus of each tooth to the apex of the mandible, measured obliquely, is 10 mm.; from the alveolus to the median line, 6 mm.

MEASUREMENTS OF SKULL IN MILLIMETERS

	175019 U.S.N.M.	*90053 A.M.N.H.*	*92430 Y.P.M*
Total length	810	820	805
Length of rostrum	496	510	481
Length from tip of rostrum to posterior end of pterygoids in median line	618		617
Maximum height from inferior border of pterygoids to vertex	301	307	306
Breadth across centers of orbits	325	332	342
Breadth between zygomatic processes	345	344	347
Breadth between bases of antorbital notches	210	213	210
Breadth at middle of rostrum	60	65	61
Breadth across occipital condyles	125	113	120
Breadth of expanded proximal ends of premaxillæ behind anterior nares	142	147	156
Minimum breadth of premaxillæ opposite anterior nares	118	115	114
Breadth of premaxillæ opposite premaxillary foramina	68	77	63

	179619 U.S.N.M.	90053 A.M.N.H.	03430 Y.P.M.
Maximum breadth of anterior nares	56	60	52
Minimum distance between maxillary foramina	92	102	90
Distance from posterior border of maxillary foramen to end of maxillary protuberance	63	65	70
Length of portion of vomer visible on palate	162	148	155
Length of mandible	668	690	707
Length of symphysis	193	210	186
Maximum height of ramus opposite coronoid process	117	117	112

In the following notes I have added further data to our knowledge of the skeleton of this species and, I hope, made easier a comparison with the skeletons of other ziphioid whales.

Hyoid bones.—(Plate 3, fig. 2) The basihyal is wider than long and has two lingual processes. The thyrohyals diverge at about a 45 degree angle and are partially fused to the basihyal. The free stylohyals are much flattened. Basihyal, length 58; width (maximum) 75. Thyrohyal, length 114; width (maximum) 39. Stylohyal, length 158; width (maximum) 38.

Vertebræ.—The vertebral formula is C 7, T 10, L 11, Ca 19 = 47. All of the epiphyses were free, except those of the cervicals and of the posterior caudals.

Cervicals.—The atlas and axis are completely fused, while the third cervical is ankylosed to the axis, both at the arch and the centrum. The fourth to seventh cervicals inclusive are free and very much compressed anteroposteriorly, but the left half of the arch of the fourth is fused to that of the fifth.

Inferior lateral processes from the centra occur on the first six cervicals, while superior lateral ones are found on all but the atlas and sixth cervical. The inferior are the larger processes, and these are directed backward on the atlas and axis, but on the others mainly outward while also slightly forward. The seventh has a large facet on the lateral lower half of the centrum for the articulation of the first rib, but the inferior lateral process is very small and rounded. The seventh is the first to bear a normal neural spine, the atlas and axis having a large rounded composite spine on the fused vertebral arches.

Thoracics.—The first thoracic vertebra has a small anterior facet directed forward and outward for partial articulation with the capitulum of the first rib, and a larger posterior facet facing in the opposite direction for the second rib. Metapophyses first appear on the diapophyses of the third vertebra, gradually increasing to assume the form of conical tubercles on the seventh, after which they flatten out and continue to the seventh caudal. Diapophysial facets for the tubercular rib articulations are found on the first 7 tho-

PLATE 3

Fig. 1. Lateral and superior aspects of tooth of *Mesoplodon mirus*. Fig. 2. Hyoid bones of the same individual.

racics, with facets on the centrum for the capitular ones on the first 6 centra. On the centrum of the eighth the first transverse process appears and the last 3 ribs are holocephalous, articulating only with the constantly enlarging transverse processes. The first trace of an inferior median ridge appears on the sixth thoracic.

Lumbars.—The transverse processes of the lumbars change from longer-than-wide in the anterior part of the series to wider-than-long in the posterior section. They are directed slightly downward and forward but mainly outward. The free ends are rounded. The centra regularly increase in length through the tenth, which is the longest in the whole column. The neural spines increase in length also through the eighth, which is the longest. The median inferior ridge is best developed about the middle of the series, decreasing in prominence on the fore and aft vertebræ.

Caudals.—The spines and transverse processes decrease in size rapidly until the spine of the eleventh is a small rounded boss. The transverse processes disappear after the seventh caudal. This process on the sixth is perforated by a vertical foramen, the position of which gradually elevates on succeeding centra until it becomes situated on the superior surface. It continues in this position to the end of the caudal series, with diminishing size. Beginning with the seventh caudal, the two inferior ridges are pierced by a foramen on either side and continue so posteriorly until the ridges disappear on the eleventh. On the side of the centrum of the second caudal a ridge appears just above the junction with the transverse process. This ridge gradually moves upward on succeeding vertebræ until it reaches the base of the neural arch, becoming less marked after the fifth and vanishing on the ninth. A poorly defined secondary ridge appears on the fifth, sixth, and seventh caudals below the other ridge and on the lateral anterior half of the centrum.

The neural canal diminishes gradually to the tenth caudal, where its diameter is but a trifle greater than that of a pencil lead.

Sternum.—(Plate 4) The five sternebræ are typical of *Mesoplodon*, although this structure varies much individually and with age. There may be only 4 segments in this species, as shown by the American Museum specimen. The manubrium is about twice the length of the second segment. The third is slightly smaller in both dimensions than the second, while the last two are considerably but proportionately reduced. The first two segments are slightly convex downward, while the last three are flat. Only the first five ribs were attached to the sternum by cartilage. Total length of five segments, 521; manubrium, length 213, width 161.5; depth of anterior notch, 46; xiphisternum, length 63, width 66.5.

Ribs.—The first 7 ribs are dichocephalous, but in the first the tuberculum and capitulum are nearly continuous. The demarcation between these articular surfaces becomes increasingly greater until in the last 3 the ribs

PLATE 4

Sternebrae of *Mesoplodon mirus*

are holocephalous. The first pair is short, broad, and much flattened. The ribs increase in length to the fifth and then gradually decrease, although the tenth is much smaller than the ninth.

Pectoral limb.—The very thin scapula is roughly triangular in outline, with the anterior crest the highest point. The anterior border is nearly straight, the crest convex, and the posterior edge concave. The acromion is very much compressed, arises from the short, poorly defined spine, and is slightly expanded at its free end. The process is directed upward at an angle of about 25 degrees.

The coracoid is more rounded, is as long as the acromion, and is somewhat expanded on the free end. It is directed forward nearly in line with the plane of the humeral articulation.

No pelvic bones were present.

SKELETAL MEASUREMENTS	*mm.*
Total length of 7 cervical vertebræ	121
Total length of first 3 cervicals	51
Total length of last 10 caudals	362
Scapula, length	315
depth	219
Length of acromion in median line	93
Length of coracoid	84
Diameter of articular surface—anteroposterior	64
Diameter of articular surface—transverse	37
Maximum length of flipper without scapula	434
Humerus, length 133; maximum width	70
Radius, length 153; maximum width	43
Ulna, length 169; maximum width, upper end	64
Maximum width in center	22

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GENITAL SWELLING IN THE FEMALE ORANG-UTAN

By Adolph H. Schultz

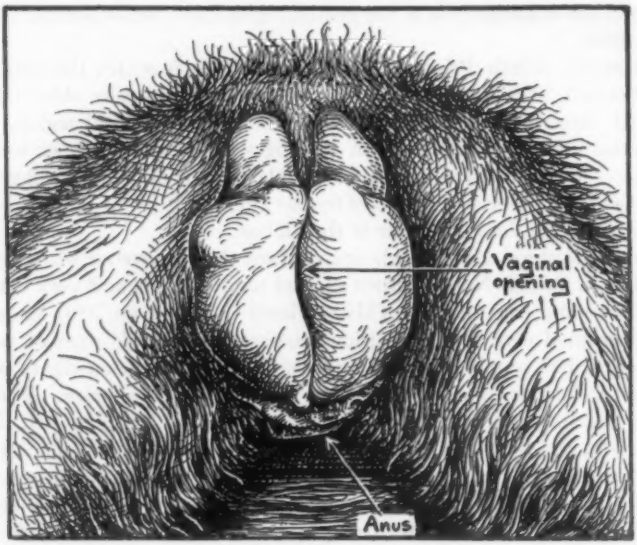
In many Old World primates the female genital region shows striking periodic swellings during adult life. Such cyclic changes in the so-called sexual skin of females are well known in several species of macaques and baboons and, among the anthropoid apes, in the chimpanzee. Recently (Raven, 1936, for mountain gorilla, and Noback, 1936, for lowland gorilla) it has been reported that in the gorilla, too, the sexual skin undergoes marked swellings. In the remaining anthropoid apes (orang-utan and gibbon) no such periodic enlargements of the genital region have been observed (Zuckerman, 1933).

During the Asiatic Primate Expedition of 1937, in which the author was a participant, over 40 wild, fully adult, female gibbons were obtained, none of which showed the slightest sign of swelling in the genital region. Since this series included individuals in all stages of the sex-cycle, as well as a number of pregnant females, and since enlargement of the external genitalia has never been observed in captive female gibbons, it seems safe to conclude that sex-swelling does not occur in the gibbon.

One of the three adult female orang-utans that the writer was permitted to collect in British North Borneo showed unmistakable and very extensive genital swelling (see figure). This specimen (A. P. E. no. 380) has a completely erupted permanent dentition showing considerable wear on most of the teeth. Her nipples are long and pendulous (38 mm. on right, 40 mm. on left), indicating that at some time she had nursed a baby. The completely hairless, shiny, pink and edematous genital swelling had, in the fresh state, the following dimensions: Greatest dorsoventral diameter, 114 mm.; greatest transverse diameter, 95 mm., greatest height (approximately), 60 mm. Considering that this animal weighed only 84 pounds and has a hip breadth (between greater trochanters) of only 216 mm., this pudendal enlargement is proportionately as great as in many female chimpanzees during the middle of their menstrual cycles. Rather unexpectedly it was found that this particular orang-utan was pregnant, containing a fetus (A. P. E. no. 381) with a sitting-height of 195 mm. and a weight of 802 grams. It is difficult to form a close estimate of the state of development of this fetus. Of two newborn orang-utans, mentioned by the writer (1933) in a previous publication, one has a sitting-height of 264 mm. and a weight of 1600 grams, and the other, a weight of 1405 grams. A third newborn orang-utan, which was generously lent to the author by Dr. W. H. Osgood, has a sitting-height of 246 mm. and a weight of 1265 grams. Compared with the size of these newborns the fetus in question must still be far from term, but has undoubtedly reached well into the second half of its intrauterine development. This conclusion is also supported by the fact that fetus no. 381

measures practically the same as, but weighs somewhat more than, another orang-utan fetus, previously described by the author (1933), of which it is definitely known that it is not older than 6 months and 11 days. The duration of pregnancy in the orang-utan is 9 months (Aulmann, 1932).

It may be recorded here that the other two adult female orang-utans collected on this expedition showed no sign of sexual swelling, the pudendal zone being exceedingly small and inconspicuous. Both these animals had been lactating, their mammary glands containing large amounts of milk. One of them had a baby, weighing 16 pounds; the other was accompanied



Genital swelling in an adult, pregnant, wild-shot orang-utan. The animal is lying on its back with its legs hanging over the edge of the supporting box (after a photograph, taken in the field, by S. L. Washburn).

by a small orang-utan which was not obtained, but appeared to be approximately 35 pounds in weight.

In the zoological garden of Medan, Sumatra, where a considerable number of orang-utans are kept under conditions that are as nearly natural as are possible in captivity, the writer was informed that enlargement of the genital region had never been noticed except in two pregnant females.

In his careful description of pregnancy and birth in an orang-utan ("Maggie") in the Philadelphia zoological garden, Fox (1929) stated, after mentioning that pregnancy was first suspected in January, that "Early in

March some slight swelling in the vulvar region was noted, and this remained stationary until during July, when it began to increase steadily". Since the living baby was born the end of September, the sexual swelling in the mother apparently reached its height some time during the last two and one-half months of pregnancy.

From a recent letter by Mr. M. I. Tomilin, the author has been permitted to quote the following information referring to an adult female orang-utan in the Philadelphia zoological garden: "During the last pregnancy of Guarina her sexual skin was enlarged, especially during the last month. It was about five inches long and three inches in diameter, hanging in large folds, slightly turgid. After parturition the sexual skin shrank and since that time up to now it has been gathered into very small wrinkles."

As far as is known to the author, noteworthy genital swelling has never been observed in non-pregnant orang-utans. During pregnancy, however, such swelling does occur in this ape, as is evident from the notes, collected here, appertaining to 5 animals. In view of the complete lack of information to the contrary, the writer inclines to the view that sex-swelling is a regular feature accompanying pregnancy in the orang-utan.

In the chimpanzee, sexual swelling during pregnancy is frequently lacking or else much less pronounced than during the menstrual cycle. Regarding these conditions in the chimpanzee, Elder and Yerkes (1936) stated: "Cycles of swelling, usually irregular, do occur during the early months of pregnancy, but the swelling does not reach the dimensions characteristic of the non-pregnant cycle." In the Hopkins chimpanzee "Evo", genital swelling persisted during the first two months of her pregnancy, although it was of quite moderate size (Schultz and Snyder, 1935). In another Hopkins chimpanzee, "Pandora", sex-swelling was present throughout most of her pregnancy, disappearing only 3 weeks before the normal baby was born. According to the author's regular records, the sex-swelling, while present, fluctuated slightly around "one-half maximum size". Zuckerman (1937) expressed himself in this matter as follows: "Signs of some sexual-skin activity are not infrequently exhibited during pregnancy in certain species (*e.g.* the chimpanzee), and I have occasionally observed slight pudendal swelling in monkeys for a week or two preceding parturition (*e.g.*, mangabeys)". Doctor C. G. Hartman has kindly informed the writer that in several females of the Indian bonnet macaque (*Macaca radiata*) the sexual skin became enlarged and colored during pregnancy, although these phenomena are entirely lacking in this species during the menstrual cycle.

It has now been definitely established that female genital swelling occurs not only in the two African great apes (chimpanzee and gorilla), but also in the Asiatic one (orang-utan), although in the latter it appears to be restricted to the period of pregnancy. In regard to the existence of this sexual swelling the three great apes are sharply differentiated from the other two higher primates, gibbon and man.

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NOTES ON SOME LATE TERTIARY AND PLEISTOCENE ANTILOCAPRIDS

BY R. A. STIRTON

The following comments and suggestions are concerned with the possible relationships and the systematic status of *Capromeryx*, *Sphenophalos*, and *Proantilocapra*. I am grateful to Dr. Walter Granger of the American Museum of Natural History for the opportunity of studying the genotype of *Capromeryx*.

Capromeryx Matthew

This genus was described by Matthew (1902; 1904, pp. 126–127) from part of a left lower jaw in which $P_2 - M_3$ were preserved. The specimen was listed as part of the Hay Springs Pleistocene fauna. Hesse (1935), however, directed attention to the similarity of the genotype with the Middle Pliocene *Capromeryx altidens* (Matthew) and stated that it was more closely allied to this species than to the Pleistocene species, *"Capromeryx" minor* Taylor and *"C." mexicana* Furlong. The teeth are very close in size to those of *Capromeryx texanus* Hesse.

Detailed measurements show that the premolars of *"Capromeryx" minor* (see Chandler, 1916) and some small antilocaprid remains (Frick, 1937, fig. 54, F: A.M. no. 25689) from Hay Springs are more fore-shortened and higher crowned than in *C. furcifer* Matthew, the genotype. Furthermore,

the anterior and posterior edges of P_3 and P_4 tend to taper, the teeth becoming narrower as they are worn down, whereas in *"C." minor*, these edges are more or less parallel and indicate higher-crowned teeth. In M_3 the third lobe is much wider and there are two inflections on the lingual side of P_3, whereas only one occurs in the Pleistocene species.

	C. altidens (MATTHEW) U. C. MUS. PAL. NO. 30610 HEMPHILL—MIDDLE PLIOCENE	*C. altidens* (MATTHEW) U.C. MUS. PAL. NO. 30455 OPTIMA—MIDDLE PLIOCENE	*C. furcifer* MATTHEW-GENOTYPE AM. MUS. NAT. HIST. NO. 2771 HAY SPRINGS—PLEISTOCENE	*C. texanus* HEMP-TYPE U.C. MUS. PAL. NO. 30337 HIGGINS—EARLY MIDDLE PLIOCENE	*C. furcifer* MATTHEW F.A.M. NO. 25689 HAY SPRINGS—PLEISTOCENE	*C. minor* TAYLOR U.C. MUS. PAL. NO. 20036 RANCHO LA BREA—PLEISTOCENE	*C. minor* TAYLOR U.C. MUS. PAL. NO. 20062
P_2–M_3	*?58.8	?59.1	†52.9	51.8	‡	?47.7	?46.6
P_2–M_2		?41.4	36.4	34.8		?30.5	32.5
P_2–M_1		?29.6	26.8	24.8		?21.6	23.1
P_2–P_4		?20.4	17.6	17.3		?13.3	15.3
P_2–P_3			10.4	10.5		?7.6	?8.3
P_3–M_3	53.7		48.7	47.2		?43.5	41.8
P_3–M_2	37.2		32.3	30.4		?26.8	28.3
P_3–M_1	24.6		21.5	20.3		?17.4	19.0
P_3–P_4	14.9		13.4	12.6		?10.3	11.4
P_4–M_3	46.8	47.4	43.3	41.9	?38.2	?38.4	36.2
P_4–M_2	30.0	29.3	26.8	24.8	?23.4	22.1	22.9
P_4–M_1	17.8	17.5	15.7	15.0	?13.9	12.6	13.7
M_1–M_3	38.7	38.4	35.8	35.1	32.5	?33.1	31.0
M_1–M_2	21.9	21.6	19.4	18.4	18.3	16.5	17.3
M_2–M_3	28.6	29.5	27.4	27.4	23.9	?25.7	23.0
P_2		?4.8	4.1	4.4		?3.1	?2.8
P_3	6.9	?6.2	5.9	5.5		4.7	?4.3
P_4	8.8	8.7	7.8	7.3	?6.5	5.7	6.4
M_1	9.8	8.9	8.6	8.2	8.5	7.1	8.2
M_2	12.4	11.7	10.9	10.1	9.7	9.1	9.3
M_3	16.5	17.4	16.5	17.0	13.7	?10.9	13.4

* Question marks indicate approximate measurements taken from alveolar borders or estimated extensions of broken edges.

† Because of the close resemblance of this species to the Middle Pliocene forms, its Pleistocene occurrence has been questioned.

‡ This specimen has been reported from the Hay Springs Pleistocene by Frick (1937). These measurements are taken from his figure.

Nor does *C. furcifer* compare at all favorably with the larger *Tetrameryx falkenbachi* Frick from Hay Springs. Actually, then, no specimen in the large collections obtained from that fauna has been proved definitely to be

conspecific with the genotype of *Capromeryx*. These facts indicate that the genotype of *Capromeryx* may have been picked up as a surface float and that it originally came from the Pliocene beds that are immediately overlain by the Hay Springs Pleistocene deposits. Hatcher (1894), and Osborn (1904, pp. 314–316), have described and referred fossils from these lower beds to the Pliocene. On the other hand, it may be argued that *C. furcifer* is a Pleistocene species less advanced in its characters than in the California and Mexican forms, but Frick's specimen no. 25689 from Hay Springs does not support this conclusion (see table of measurements). Likewise, his figure (52A, F: A.M. 31749) of a much larger specimen from "Stegomastodon quarry", Nebraska, does not conform in size nor in the construction of the premolars with the genotype.

Unfortunately, no horn-cores of any individual have been found associated with its cheek-teeth in the Pliocene species of *Capromeryx*. Recently Frick (1937, fig. 50, F: A.M. no. 31675) figured and described (p. 474) a widely-forked, short-based, but fragmentary horn-core from the Optima, Oklahoma, fauna that he assumed to belong with the teeth known to be typical of *Capromeryx altidens* (Matthew). Frick, however, did not take up the interesting points in Hesse's paper but continued to recognize the horn-cores of "*C.*" *minor* as typical of the genus, and proceeded to give his newly found horn-core the name *Texoceros guymonensis*. The name *Texoceros* must stand until it is definitely proved with which teeth it belongs. If, as Frick proposed, the horn-core actually belongs with the dentition shown by Hesse to be *Capromeryx*, then *Texoceros* automatically becomes a synonym of *Capromeryx*.

The status of "*Capromeryx*" *minor* Taylor and "*C.*" *mexicana* Furlong is still unsettled. If the Optima horn-core is not correctly associated with the teeth from that locality, which Hesse referred to *C. altidens*, there is still a possibility that the Pliocene genus possessed horn-cores like "*C.*" *minor*. On the other hand, if that association be correct, two important points are clarified. First, *Capromeryx* is evidently ancestral to the Pleistocene *Tetrameryx*, and, second, the small Pleistocene species "*C.*" *minor* and "*C.*" *mexicana* need a new generic name.

Sphenophalos Merriam

Sphenophalos seems to be more widely distributed and perhaps is better known than any of the late Pliocene antilocaprids. The genus was based on the basal portion of an adult horn-core that Merriam (1909) described from the Thousand Creek fauna of Nevada. Since that time, Merriam, Stock, and especially Furlong, have added considerably to our knowledge of the genus.

Furlong's (1931) carefully prepared report clearly demonstrated the variation displayed by horn-cores evidently belonging to animals of different ages. The younger animals possess narrower (transversely) and more flat-

tened horn-cores than the adults. This point is supported (Stirton, 1932) by a pair of fragmentary horn-cores from Thousand Creek which were found with the three upper molars of a young adult. Frick (1937) failed to recognize the significance of this evidence and relegated *Sphenophalos* to obscurity in his book "Horned Ruminants of North America" by describing a new genus *Plioceros*, to which he assigned all of the described *Sphenophalos* horn-cores except Merriam's genotype and another horn-core from the Rattlesnake of Oregon. He suggested that *Sphenophalos* may be closely related to another of his new genera, *Osbornoceros*; a view which seems to be even less plausible.

The exact geological age of the species described by Frick (*Plioceros blicki*, *P. floblairi* and *P. dehlini*, figs. 50 and 26) from New Mexico and Nebraska is not recorded; but they seem to be more primitive than the Middle Pliocene specimens from Nevada and Oregon. They are obviously related to *Sphenophalos*, and sufficient evidence has not been presented for the recognition of another genus. *Plioceros* is, then, a synonym of *Sphenophalos*. More information on these specimens would be welcomed.

Furlong has shown that *Sphenophalos* is very closely related to *Antilocapra*; and the evidence now available indicates that it is nearer to the later Pliocene ancestry than any known genus. Yet there are a few points that militate against placing it in the direct ancestry of the modern genus: (1) The anterior prong is too well developed; (2) the horn-cores are too massive, and their anterior margins are not so sharply V-shaped; (3) there is a definite outward twist of the anterior and an inward twist of the posterior borders not evidenced in *Antilocapra*.

Proantilocapra Barbour and Schultz

Proantilocapra platycornea Barbour and Schultz (1934) also has been proposed as the direct ancestor of the pronghorn; but a detailed description of the beautifully preserved skeleton has not been published. A Lower Pliocene age is assigned to the specimen; but Paul O. McGrew, the collector, informed me that it was found below stream channel sands that seem to be equivalent to those in which the Burge Lower Pliocene fauna was found.

Since *Sphenophalos* specimens have been found at Santa Cruz and Battleship Mountain in New Mexico, it seems quite unlikely that *Proantilocapra* is in the *Sphenophalos* line of descent, unless *Proantilocapra* is a member of the Niobrara River Upper Miocene fauna and the New Mexican specimens are Lower Pliocene. More geologic and faunal evidence should be published before accurate age determinations can be made.

Barbour and Schultz stated that "The most important and typical single structure of this ancestral antelope is the horn-core, which is characteristically flattened as in *Antilocapra*, but differs from the latter in having a large tuberous tip. The teeth are hypsodont and are almost indistinguish-

able from *Merycodus*, but the angle of the mandible is more prominent and the cheek-tooth series somewhat more slender and higher-crowned and P_3 smaller than the nearest Merycodine form, *M. necatus sabulonis* Matthew and Cook." Structurally, *Proantilocapra* seems nearer to the ancestral line of *Antilocapra* than any known genus unless it is eventually proved that typical *Capromeryx* possessed horn-cores of this type. A cross-section of the *Proantilocapra* horn-core displays a blade-like outline as in the living genus; then, too, the horn is not twisted as in *Sphenophalos*. A greater development might be expected to take place above the posterior and heavier area which would be supplied with more active replacement tissue. This may account for a development of the posterior part of the horn-core and a retardation of the anterior blade almost as in the position seen in *Proantilocapra*.

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GENERAL NOTES

SEPARATES OF SCIENTIFIC PAPERS

Mammalogists as a whole exhibit toward separates of zoological papers a prodigal recklessness and thoughtlessness which, if not checked, will make systematic work extremely arduous for posterity. I refer to the practice of many workers regarding separates sent to them as their own property. This does not matter in cases where a second copy is sent to the library of the institution where they work, but it is by no means always that this is done.

The separate, then, disappears into the worker's home and may never be seen again. Even if the culprit has the intention of leaving his library to the institution, other workers are in the meantime deprived of the use of the separates; moreover, his intention may miscarry and priceless separates may be thrown away as junk.

It seems quite clear that in cases where the institution's library has not been sent a second copy, the worker has little moral support for claiming the only copy. It may be argued that the separates which an author receives are in exchange for his own and that therefore he is entitled to them, but he would be unable to produce papers at all without the facilities (and often the salary) provided by the institution in which he works.

It is no answer to say that other workers can always go to the publications in which the papers originally appeared. Anyone who has tried to do much systematic work without a good library of separates will appreciate the callous indifference indicated by this specious argument.

I would urge most strongly that authors send one copy of their papers to the mammal department libraries of all the most important museums of the world, and that it should be clearly indicated that such copies are for the use of the department. Only when this moral duty has been fulfilled should personal copies be sent to individuals.

All separates sent to me are stamped as belonging to the mammal room (unless they are duplicates) and go into tract boxes under authors' initials. When sufficient papers of one author have accumulated they are indexed and bound. This author's works are therefore available not only to my colleagues and to visitors, but are there for posterity.

I have been moved to write this because I receive so many requests for complete sets of the papers of the late Oldfield Thomas. If these had been treated as I suggest, there would have been sets in the principal museums of the world. As it is they were unfortunately broadcast to anyone who asked for them without a guarantee that they would by placed where they would be permanently available. Until last year authors received only 30 copies (now raised to 50) of papers in Proc. Zool. Soc. Lond. and not many more (now 75) of papers in Ann. Mag. Nat. Hist., so it is not surprising that Thomas' separates soon were exhausted.—T. C. S. Morrison-Scott, *British Museum (Natural History), London.*

ADDITIONAL RECORDS OF THE PIGMY SHREW IN NEW HAMPSHIRE

The first record of *Microsorex hoyi thompsoni* for New Hampshire was reported by the writer (Jour. Mamm., vol. 18, p. 362, 1937) as having been taken at First Connecticut Lake in August, 1936. Two additional specimens of this shrew were trapped on September 30, 1937, at Pinkham Notch, Coos County, New Hampshire.

A line of traps was maintained for a week in a sphagnum bog directly opposite the Appalachian Mountain Club lodges. These were set at intervals of 5 feet along the margin of a small brook that wound its way between thick clumps of alder bushes. The first specimen was discovered in the morning and another about 4 P.M. The latter animal was still warm. Both traps were set close to the base of alder clumps within two feet of the brook. The following data were recorded: N.A.P. no. 927. Female; weight,

2.7 grams; length, 83; tail vertebrae, 31; hind foot, 11 mm. N.A.P. no. 938. Male; weight, 3.2 grams; length, 81.5; tail vertebrae, 30.5; hind foot, 11 mm.

It is of interest to note that all of the New England records of this rare mammal are within the Canadian Zone, whereas the known distribution of *thompsoni* extends to the Upper Austral Zone. It seems not unlikely, if a concerted effort be made, that this form will be found in suitable localities throughout most of New England.—Norman A. Preble, *119 West Tenth Avenue, Columbus, Ohio.*

MICROSOREX HOYI WASHINGTONI IN MONTANA

On October 8, 1937, 7 miles east of Thompson Falls, Sanders County, Montana, I collected a Washington pigmy shrew, the first record of the species in Montana and the second of the subspecies. This record extends the known range of the race about 115 miles east southeast from the type locality at Loon Lake, Stevens County, Washington.

Both the well worn teeth and the pronounced cranial ridges indicate that the specimen (Mus. Vert. Zool., no. 80762) is fully adult. The shrew matches the description given for *Microsorex hoyi washingtoni* by Jackson (North Amer. Fauna, no. 51) excepting only in the lesser cranial breadth—6.2 in contrast to Jackson's measurement of 6.6 mm. for the type specimen. However, the type had the "posterior and basal portion of the cranium broken", and may therefore have been less than 6.6 mm. In comparison with specimens of *M.h. intervectus* and *M.h. hoyi*, the skull is obviously smaller, it appears to be more elongated, the sides of the cranium in dorsal view are less angular, and the maxillary processes are more pronounced. As with the type specimen of *M.h. washingtoni*, the shape of the skull more closely resembles that of *M.h. thompsoni* than of either of the other mentioned subspecies.

The body measurements (82 x 31 x 9) also are nearly the same as those given by Jackson for *M.h. washingtoni*. The color, too, agrees with Jackson's description of the summer pelage, and is decidedly more reddish than in any other specimens of *Microsorex* examined.

This shrew was captured alive, just before noon, as it was running across a dirt road about 100 feet from Thompson River. Surrounding the spot was an open forest of second growth ponderosa pine, western larch, and Douglas fir with little undergrowth. Although imprisoned for over an hour in a match box before being killed in a cyanide jar, the shrew was at no time heard to utter a sound.—Carl B. Koford, *131 Highland Avenue, Piedmont, California.*

THE NEST OF CRYPTOTIS FLORIDANA

The nest of this shrew apparently has escaped the notice of collectors, as I have been unable to locate any mention of it in literature.

While walking along the marshy woods at the northeast end of Lake Jessup, near Sanford, Seminole County, Florida, F. M. Uhler and I found a nest of this species containing two individuals, one of which was collected. The nest was under one end of a prostrate cabbage palm (*Sabal palmetto*) on damp soil about 150 feet from water. The immediate vicinity was a forest of cabbage palms with an understory of waxmyrtle (*Myrica cerifera*) and scrubby live oaks (*Quercus virginiana*). The log and entrance to the nest were overhung by a spiny nightshade (*Solanum* sp.). The nearby marsh was of a *Spartina-Sesbania* type.

There were several tunnels, two short laterals about 8 inches long opening under the same side of the log, and the main tunnel running the full 6-foot length under the log. One of the laterals opened into the nest and the other into the main tunnel about 2 feet away from the nest.

The nest was loosely constructed of leaves of panic grass (*Panicum mutabile*) and was

about 5 inches in diameter. There was no evident attempt at weaving or any other means of fastening the leaves in place; they were loosely piled in a globular mass. Small pieces of shed snake skin, seemingly from a Florida king snake (*Lampropeltis getulus floridanus*) were mixed with the leaves, and were also scattered about the sides of the log away from the nest.

The runways were of a diameter just large enough to accommodate the shrews and the tops were covered only by the log. Upon leaving the log, the runways in some cases led to the surface, where they became paths, and in other cases led to shallow runways under the surface of the humus that surrounded the log.

Identification of the panic grass was made through the courtesy of Mrs. Agnes Chase of the Bureau of Plant Industry, U. S. Department of Agriculture.—CLARENCE F. SMITH, *U. S. Biological Survey, Washington, D. C.*

FRINGED-TAILED BAT IN BRITISH COLUMBIA

On July 19, 1937, I took 6 *Myotis thysanodes thysanodes* (Mus. Vert. Zool. nos. 77384–89) from a colony of 30 to 40 individuals in the attic of Mrs. E. P. Chapman's home in Vernon, British Columbia. This place is 300 miles north of Anatone, Asotin County, Washington, the northernmost record station for this species mentioned by Miller and Allen in "The American bats of the genera Myotis and Pizonyx" (Bull. U. S. Nat. Mus., no. 144, pp. 122–128, 1928). The country immediately about Vernon is, for the most part, hilly and mountainous; the valleys are used for apple growing and truck gardening. The hills to the west and south are mainly open grassland, but the mountains to the east are wooded, chiefly with Douglas fir. There are numerous ponds and lakes about the country. Mrs. Chapman's house lies among orchards in a narrow valley northeast of Vernon, close to the wooded mountains. The foraging area of these bats was unknown.

Three of the bats taken were adult females, without fetuses; the other three young males. The colony as a whole, moreover, appeared to have a good many young bats in it. Possibly no adult males were present, in which case this colony agrees with that at Cloverdale Hills, New Mexico (*fide* Miller and Allen, *loc. cit.*), where no adult males occurred with females during the parturition period.

The three adults agree with near-topotypes (from Tejon Ranch, California) in color and with previously known specimens in measurements, except that the zygomatic breadth averages slightly greater. This is 10.9, 10.6, and 10.8 mm., respectively, as opposed to an average of 10.4, with a maximum of 10.8, as recorded by Miller and Allen.—T. P. MASLIN, JR., *Museum of Vertebrate Zoology, University of California, Berkeley, California.*

THE FISHER AS A FOE OF THE PORCUPINE IN NEW YORK STATE

It is generally agreed that the fisher is a deadly foe of the porcupine, but definite records from New York State seem to be lacking, and therefore the following accounts may be of interest.

On Hague Mountain, July 17, 1926, I found a porcupine alive but hamstrung in both hind legs. It is believed that the injury was caused by the attack of a fisher and the observation recorded below strengthens this belief.

About 5 miles southwest of Indian Lake Village, on November 10, 1928, I saw a fisher fighting a porcupine. The latter did not seem to offer much resistance and as I approached, the fisher halted, looked at me, seemed to hesitate, then snarled and made off. Twice it stopped and looked back. Upon examining the porcupine, it was found to be hamstrung; the abdomen was ripped open and the animal was evidently unable to walk.

The day before, while hunting at the base of Blue Mountain, I came upon a freshly killed porcupine and tracks in the snow clearly indicated that the killer had been a fisher.

The trail showed plainly that the battle must have been in progress for some time, for the victim was 30 feet from the point of first attack. The abdomen was ripped open and the entrails had been eaten.

My last observation was made near Tennant Lake, Saratoga County, on November 7, 1932. A partly eaten body of a porcupine was located, and in the snow the tracks of a large fisher identified the killer. The trail led down the rocky north side of Tennant Mountain and on toward Wilcox Lake.

It is a well established belief that the quills of the porcupine have no harmful effect upon the fisher, and my limited experiences agree with this concept. A male fisher weighing 11 pounds, taken on Roger Mountain, Essex County, in April, 1926, and a female of 5.5 pounds taken near Indian Lake in November, 1928, are the only fishers that I have skinned. In both of these animals quills were found in the back. These lay just under the skin. No infection or disturbance of any kind was in evidence.—W. J. Schoonmaker, *New York State Museum, Albany, New York.*

FEEDING BEHAVIOR OF A SKUNK

During the summer of 1934, I was engaged in a study of the mammals of the Bad Lands and Black Hills of South Dakota, conducted under the auspices of the Museum of Zoology of the University of Michigan.

Early on the morning of July 10, I captured a young male skunk (*Mephitis hudsonica*) near the White River south of Kadoka. He proved to be so tractable that he was kept as a pet for some time.

The skunk was fed mostly deermice (*Peromyscus*) of several species. Raw hens' eggs, apples, lettuce, peanuts, and sunflower seeds were added to his diet for variety. His daily capacity for deermice averaged about 7 individuals. They were fed to the skunk alive and all at one time, whereupon he immediately proceeded to capture and kill each mouse by crushing the skull with his teeth. This task was usually quickly accomplished, and not until all the mice were killed would he begin lustily to devour them. In consuming the mice he would always begin with the head and end with the tail.

On one occasion he was given two live white rats. These were quickly killed, although with somewhat greater difficulty than the deermice. After killing them, he refused to eat them in spite of the fact that he was given no other food for 4 days. Periodic inspections of the rat carcasses, however, indicated that he had mauled them frequently.

Probably the most interesting mannerism observed concerned the way in which he obtained the contents of hens' eggs. First he tried to open an egg by biting it vigorously, but his mouth was too small to permit him to secure an effective purchase upon it. He then walked around the egg several times, cuffing it with a front foot as he encircled it. This method was likewise of no avail. Eventually he straddled the egg, grasping it with his front feet in a manner not unlike that assumed by the center of a football team while waiting for the signal to snap back the ball. Now he forcibly passed the egg between his hind legs, apparently in an attempt to strike an object with it. Immediately upon snapping the egg, he would look or turn around as if to locate the egg or to see if it was broken. After a few trials he broke it against a stone window sill. Then he lapped up the contents.

Thereafter, whenever he was given an egg, he straightway proceeded to break it in the manner just described.—A. M. Stebler, *Game Division, Michigan Department of Conservation, Lansing, Michigan.*

BADGERS FEED ON RATTLESNAKES

My observations while studying the habits of the prairie rattlesnakes seem to justify the conclusion that they are common food of badgers. Although the evidence is mainly

circumstantial it is convincing. Since these mammals are nocturnal it is almost impossible to witness their feeding. Then, too, they undoubtedly capture most of their prey in burrows.

It is a common experience to find where badgers have enlarged and entered abandoned prairie dog holes in which these snakes are assembled for the winter. I have seen this in more than 100 cases within the past four years. That this may be clearly understood I shall relate one such instance. One afternoon during October, 1935, near old Fort Sully, in western Sully County, South Dakota, I discovered a large group of rattlers gathering in an abandoned section of a dog town. They were scattered over an area of about five acres and some could be seen near a number of holes. Large numbers had congregated near three holes. I watched them until they retired for the night. The following afternoon I returned with friends to kill them, and upon arrival we found that a badger or badgers had enlarged and entered the three holes referred to and none of the others. I visited these holes several times afterward and failed to find any rattlesnakes in or around them.

I did on one occasion about 10 years ago witness a badger feeding on a rattlesnake near Lusk, Wyoming, and in two instances saw the partial remains of this snake near badger holes. One of these observations was made in Stanley County, and the other southwest of Kadoka, South Dakota. There is also proof that badgers feed on rattlers after the latter have been killed and left on the prairie during control operations.—A. M. Jackley, *Pierre, South Dakota.*

NOTES ON MATING AND BREEDING HABITS OF FOXES IN NEW YORK STATE

Red Fox.—Near Poestenkill, February 12, 1936, the red fox (*Vulpes fulva*) had begun mating activities and double lines of tracks were evident in the snow. This was also true on February 13, 1928, near East Schodack and De Freestville. At Tennant Lake, Saratoga county, on February 29, 1936, the animals were mating and their rather high-pitched barking could be heard more or less throughout the night.

So far as I can determine, the sexes remain together and both work in preparing the den, which is often a remodelled woodchuck burrow. Even after the pups are born the union remains intact and it is a fact that the male aids in rearing the family.

On May 29, 1933, near Sliters Corners, Rensselaer County, I observed a family of 7 foxes, comprising both parents and 5 young, before their home den. Evidently the home became crowded as the young increased in size and two of the offspring were moved to another den about 50 yards distant. The mother seemed to care for the three pups in the home den while the father appeared to be in charge of the others.

On June 4, some one dug out the den in which the infants were born and took the 3 youngsters, but the parents were not secured. That very night the remaining pair of pups were moved by the parents to a new home about one mile from the old den and, so far as I know, they were not again disturbed.

The number of young foxes in a litter varies, and I have recorded the following: Nassau, April 25, 1926, 5 young still in the den; Nassau, May 2, 1926, 5 young still in the den; Nassau, May 5, 1926, 6 young still in the den; Sliters Corners, May 29, 1929, 4 young; Sliters Corners, May 29, 1933, 5 young; De Freestville, May 15, 1936, 3 young; and De Freestville, August 4, 1936, 3 pups near the home den with both parents.

Gray Fox.—On Feburary 3, 1928, in John Boyd Thacher Park, Albany County, the tracks of the gray fox (*Urocyon c. cinereoargenteus*) were in double sets and it was evident that the animals were running in pairs. Early in the afternoon of the same day I saw two foxes in a deep rocky gully and was fortunate in witnessing them copulating.

Tracks in the snow near Rensselaer, on February 5, 1930, indicated that foxes were then paired and running together.

In Thacher Park, on March 9, 1924, the animals were mating and two male foxes met

in combat near the edge of the Helderberg Cliff at "Canopy Rock." They fought to the very edge of the sheer rock wall and in an avalanche of snow fell to their death 90 feet below. Tracks showed that a third fox, probably a female, had witnessed the battle.—W. J. SCHOONMAKER, *New York State Museum, Albany, New York.*

TREE-CLIMBING BY A GRAY FOX

As the tree-climbing habit of the gray fox has been frequently reported, the following is intended only as an addition to the list of records.

This observation was made about 2:30 P.M. in mid-April, 1933, in Oktibbeha County, approximately one-half mile from the main campus of Mississippi State College. The weather was warm and very bright. A zoology class of some 30 students, under the direction of Professor E. W. Stafford and the writer, was working in a hardwood-loblolly pine flat, with dense under-growth, when a student discovered a fox (probably *Urocyon cinereoargenteus floridanus*) in a much-branched red gum about 2 feet in diameter. When first observed by the writer the fox was about 20 feet above the ground, lying in a large crotch, its head flattened on its fore paws. The animal was facing the class, which quickly and more or less excitedly gathered on the near side of the tree. After perhaps 2 minutes, during which the fox did not move, a boy began climbing the tree on the side to the rear of the animal. Still the fox did not move. When within reach, the boy caught the fox by the tip of the tail, causing it to spring instantly and violently into action. After jumping up and down 2 or 3 times, while freeing its tail from the boy's grasp, it plunged headlong down a drooping branch, leaped to the ground, and swiftly ran off through the brush.

During the whole time the fox did not bark or whine loud enough to be heard at a distance of about 40 feet. The sex was not determined, but it is considered likely that the animal was a male.

Examination showed that the crotch was worn smooth, indicating frequent use, probably as a resting or sunning spot or as a lookout, and occasionally, perhaps, as a means of escape from dogs. The method by which the fox climbed the tree appeared, from scratches and dislodged moss and bark, to be that of jumping from one branch to another.—LEE E. YEAGER, *Plankinton Arcade, Room 7138, Milwaukee, Wisconsin.*

BLUE OR DILUTE MUTATION IN ALASKAN LYNX

The U. S. National Museum has received, as a gift from Mrs. Charles D. Walcott, the skin of a lynx from Alaska. As the specimen was obtained through the fur-trade, no further record is available.

This skin has not the fawn color that is normal in this species. It is bluish gray all over, with the usual pattern of pale belly and inside of limbs, dark ear-tufts and tail-tip. But in this specimen the usual black has been turned to bluish gray, and what should be fawn is a very pale tint of buff. In short, the animal represents a mutation known in many mammals, but more particularly in domesticated types, as dilute (or d). In the domestic cat, in which it is common, it corresponds to the maltese shade, but is distinguished from the standard breed by the presence of the normal dominant type of the agouti series (white belly) whereas the Maltese breed is the dilute form of recessive all-black (non-agouti). That this is really this mutation, and not chinchilla, is proved by the entire absence of black, even in the ear-tufts and tail-tip, which are deep bluish gray. The mutation is known to furriers, and is said to occur about once or twice in 1000 skins.—ERNST SCHWARZ, *U. S. National Museum, Washington, D. C.*

EXODUS OF NORWAY RATS FROM FLOODED AREAS

While making some observations on the relations of floods to wildlife in the Ohio Valley during the years 1935–1938, I noticed large numbers of dead Norway rats (*Rattus*

norvegicus) on the highways adjacent to flooded cornfields in the bottomland west of Portsmouth, Ohio. State Route 73 and U. S. Route 52 have been elevated so that recurring high waters seldom cover them, but the bottomlands on either side of these roads are flooded several times yearly. At the onset of flooding, Norway rats are driven from the cornfields on one side of the highways, and when they attempt to cross to the opposite side, are killed by passing motor traffic. On March 20, 1938, I counted 63 dead rats on a one-mile section of Route 73, extending from Portsmouth city limits westward to the village of Nauvoo. On the following day, 84 were counted. It is impossible to estimate the additional numbers of rats killed in the water or on piles of débris by people armed with rifles, clubs, and rocks. The Norway rat population of Portsmouth, a city of about 50,000 inhabitants is therefore controlled to some extent by movements of rats from the city to nearby cornfields in winter, and their subsequent destruction with the arrival of spring floods.—Floyd B. Chapman, *Ohio State University, Columbus, Ohio.*

THE PINE MOUSE OF SOUTHERN OHIO

At the time of Bailey's revision of the voles (North Amer. Fauna, no. 17, 1900), but one Ohio specimen of pine mouse was available to him, and this was identified as *Microtus* (*Pitymys*) *pinetorum scalopsoides*. In subsequent literature this is the form listed as occurring in Ohio.

Since 1900 there have been taken in the state of Ohio approximately 150 specimens of *Pitymys*, the majority of which are in the Cleveland Museum of Natural History and the Ohio State Museum. Examination of the material in these two institutions reveals the fact that the pine mice of the extreme southern tip of Ohio are closer to the race *auricularis*, the form found from southern Indiana and northern Kentucky to Mississippi, and should be referred to it. Specimens clearly referable to *auricularis* are on hand from but three localities: Ripley, Brown County; Smoky Creek, 1 mile west of Rome (Stout P.O.), Adams County; and Symmes Creek, 1 mile north of Chesapeake, Lawrence County. All three sites are less than one mile from the Ohio River. Specimens from these localities are more richly colored in both winter and summer pelages and have larger and more conspicuous ears than do examples from farther north. There is little difference between the two groups in size or in cranial characters. The shape of the interpterygoid fossa seems to be of slight value as a diagnostic character of Ohio *Pitymys*, as in most Ohio juveniles and young adults it is V-shaped, while in old adults it is quite generally U-shaped, suggesting that the form of the fossa may be a developmental character.

While all the pine mice of the southern half of the state may be regarded as somewhat intermediate between topotypical *scalopsoides* and topotypical *auricularis*, strictly intermediate specimens are on hand from only the southernmost tiers of counties. Thus the few skins from Clermont, Clinton, and Madison counties are only intermediate between the Ohio extremes, while those from Hocking and Fairfield counties and points north grade rapidly into typical *scalopsoides*. It should be added that summer-caught *scalopsoides* from the Cleveland region are indistinguishable on the basis of color alone from winter-caught *auricularis* from the Ohio River; in making comparisons, specimens of comparable pelage must be used.

I am indebted to Mr. Edward S. Thomas of the Ohio State Museum for the loan of specimens. Ohio specimens of *auricularis* have been examined from the following counties: Adams, 8; Brown, 4; Lawrence, 1; Clermont, 1.[1] Specimens of *scalopsoides*, from Clinton, 1[1]; Hocking, 1[1]; Madison, 4[1]; Fairfield, 14[2]; Cuyahoga, 21; Lake, 9; Geauga, 38.—B. P. Bole, Jr., *Cleveland Museum of Natural History, Cleveland, Ohio.*

[1] Ohio State Mus. [2] 12 in Ohio State Mus., 2 in Cleveland Mus.

SYNAPTOMYS BOREALIS FROM GODBOUT, QUEBEC

In 1918 the late Napoleon Comeau donated to the Royal Ontario Museum of Zoology a number of small mammals taken at Godbout, Quebec. Among these specimens was an individual preserved in formaldehyde and labelled "*Synaptomys fatuus*." The skull of this specimen (R. O. M. Z. no. 24-12-8-8) was removed from the skin and proved to be that of *Synaptomys borealis*. So few representatives of this species have been taken in eastern North America that it has seemed worth while to put the matter on record.

The dorsal coloration of the specimen is orange cinnamon, but after years of immersion in preservative the present color is not reliable. No indication is given as to the condition of the animal at the time the measurements were taken, but they are recorded as follows: Total length, 109; tail, 19.75; hind foot, 19.5 mm. The skull, which is in a fair state of preservation, affords the following measurements: Condylobasal length, 22.3; rostral length, 5.6; rostral breadth, 4.5; zygomatic breadth, 14.1; lambdoidal breadth, 10.5; incisive foramen, 4.6; and height, 8.2 mm. The animal is a young adult and in skull proportions and size of body approaches *Synaptomys borealis innuitus* of Ungava Bay, rather than the geographically nearer forms *S. b. medioximus* and *S. b. sphagnicola*.

It is interesting to note in this connection that A. B. Howell (Revision of the American lemming mice, North Amer. Fauna, no. 50, 1927) has remarked (p. 23) that a skull from Echimamish River, Manitoba, approaches closely to *Synaptomys borealis innuitus*. While tentatively recording the specimen as *S. b. borealis* he stated that it is not at all typical of that form and suggested that it may possibly represent another subspecies, an hypothesis to which the Godbout specimen may be considered to lend support.—E. C. Cross, *Royal Ontario Museum of Zoology, Toronto, Ontario.*

NOTES ON THE HOME RANGE OF THE PORCUPINE

Although the home range of the porcupine (*Erethizon d. dorsatum*) has been discussed, definite records of this phase of the animal's life are not numerous. Therefore, the following data are offered:

Near Brant Lake, New York, on January 1, 1929, I tracked a porcupine from its den in a group of hemlocks. The distance was paced off and calculated as 50 feet. On January 20, 1929, the scene was again visited and a well-worn trail in the snow plainly showed that the animal had travelled to and from the hemlocks a great deal. Absence of tracks elsewhere was definite evidence that this individual had not gone elsewhere during the 20 day period indicated above.

In the same locality on January 18, 1929, a porcupine was observed in a hemlock that was one of a group of 8 trees. Three days later I found this animal in the same place and tracks in the snow proved that it had not gone from the group of hemlocks during that interval.

On May 15, 1933, near Tennant Lake, Saratoga County, New York, I watched a small porcupine gnawing on a stump at a salt lick. When it tired of this activity it climbed about 10 feet up in a small poplar tree that was 5 paces from the stump. The following day it was in the same tree. The next day, May 17, the animal was still at the salt lick but it later climbed into the same poplar tree.

In contrast to this observation, on May 16, 1933, I tracked a porcupine from a hemlock swamp near the top of Tennant Mountain to my camp at the foot of the mountain where the animal was found gnawing an axe handle. The distance was estimated to be about three-fourths of a mile.—W. J. Schoonmaker, *New York State Museum, Albany, New York.*

PARASITES OF THE SNOWSHOE HARE

On November 22, 1935, I discovered a round worm in the bursa of the tarsal joint in the hind foot of a snowshoe hare, *Lepus americanus phaeonotus*, which has not heretofore been described in this specific host. The hares were taken in Lake of the Woods County, Minnesota. Dr. William A. Riley identified the parasite as *Filaria scapiceps* Leidy (Proc. Acad. Nat. Sci. Philadelphia, vol. 38, 1886, p. 308). It was originally found beneath the skin of the hind foot of *Sylvilagus floridanus*. In 1894 Stiles and Hassell, in their list of the parasites found in the collection of the Bureau of Animal Industry at Washington, reported this species in *Lepus campestris*[=*townsendii campanius*]. M. C. Hall (Proc. U. S. Nat. Mus., vol. 50, 1916) reported it as occurring in the subcutaneous tissue and under the fascias of *Sylvilagus floridanus alacer*, *S. floridanus mallurus*, and *Lepus campestris*[=*townsendii campanius*].

During the winter of 1936-1937 and again during the winter of 1937-1938, the presence of this worm was noted in approximately one-third of all specimens of snowshoe hares examined in northern Minnesota. Infestation is accompanied by a slight deterioration of tissue which does not seem to interfere with the mobility of the animals. Usually 2 to 4 were found in each leg, with a maximum of 7, of which 4 were large and 3 were small. Usually both hind legs harbored the round worms.

The infestation became progressively heavier from October through February, and then declined until the middle of July. During the late summer and fall months, no evidence of the presence of the parasite was found, although numerous collections and examinations were made. It is possible that it passes from the host during the early spring months.

On November 1, 1937, Mr. R. D. Montgomery and the author found a small stomach worm, identified by Dr. William A. Riley as *Obiliscoides cuniculi*, in the snowshoe hare. Subsequent examination revealed that this was a common parasite of the hares. The numbers found in the stomachs ranged, usually, from 50 to 100, although in some instances only a few were present. No evidence of injury was detected.

Ticks also are very common on snowshoe hares in northern Minnesota during the spring and summer months, but are not found during the winter months. Hence, none of the animals examined were parasitized by *F. scapiceps* simultaneously while harboring ticks.—J. MANWEILER, *Farm Security Administration, Milwaukee, Wisconsin.*

NOTES ON THE OCCURRENCE OF BISON NEAR THE GULF OF MEXICO

In a letter written in 1675 by Gabriel Diaz Vara Calderon to the Queen Regent of Spain, describing Florida and the Florida missions and containing notes regarding the Indian tribes, there is mention of the occurrence there of bison. The Indians were under his pastoral jurisdiction and he had just returned from a visit among them covering about 10 months. This letter was printed as volume 95, no. 16, of the Smithsonian Miscellaneous Collections under the editorship of Dr. Lucy L. Wenhold, of Salem College, Winston-Salem, North Carolina, with an introduction by myself. On page 13 is the statement that during January the Indians "burn the grass and weeds from the fields preparatory to cultivation, surrounding them all at one time with fire so that the deer, wild ducks, and rabbits, fleeing from it fall into their hands. This sort of hunting they call *hurimelas*. Then they enter the forests in pursuit of bears, bison (cibolas) and lions [i.e. panthers] which they kill with bows and arrows, and this they call *ojêo*." The original Spanish will be found on pages 9 and 10 of the facsimile following.

While it is possible that this chase may have extended into southern Georgia, it probably did not go far in that direction because the Florida Indians were then at war with the Georgia Indians and their protectors, the English.

A second instance is in the "Relation de Pénicaut," a French ship carpenter, who accompanied Iberville in his second voyage to Louisiana and after spending several years in the New World, returned to France and compiled his memoirs, which were later printed by Pierre Margry in his well-known "Découvertes et Établissements des Français dans l'Ouest et dans le Sud de L'Amérique septentrionale", vol. 5, pp. 375–586. He made no attempt to check his memory of events by means of official records; he mixes or transposes the events of different years and has to be watched continually, but his material is full of direct observations of real value and in the present instance I see no reason why he should have misrepresented the facts, although he may have misdated the occurrence by a year or two. It is listed among the events of the year 1708. Mention of the bison is contained in the following paragraph, which I give entire:

"Je ne puis m'empescher de raconter icy l'action de deux François qui ne sera pas, je crois, désagréable au lecteur. Le gouverneur de Pensacola pour le Roy d'Espagne envoya prier MM. d'Artaguiette et de Bienville de luy envoyer trois ou quatre de leurs chasseurs pour luy tuer du gibier. MM. d'Artaguiette et de Bienville luy en ayant envoyé quatre, ils allèrent chasser dans les bois aux environs de Pensacola. Deux d'iceux, dont il y en avoit un qui se nommoit Saint-Michel et l'autre Moquin, furent rencontrez, en chassant dans ces bois, par un party d'Alibamons qui les entourèrent et les prirent. Ils les menèrent ensuite à huit de la, où ils restèrent pour y coucher jusqu'au lendemain. Quand les Alibamons furent à cet endroit, ils demandèrent à ces deux François ce qu'ils estoient venus faire aux environs de Pensacola. Les deux François, qui entendoient bien la langue mobilienne, dont ils leur avoient parlé, leur respondirent qu'ils y estoient venus chasser pour le Gouverneur de Pensacola. Deux des chefs du party leur dirent qu'ils les menèroient le lendemain à la chasse pour voir s'ils disoient vray. Et, en effet, le lendemain matin les deux Sauvages rendirent leurs fusils aux deux François, et les menèrent avec eux à la chasse. Par bonheur pour les François, ils trouvèrent une bande de bœufs sauvages, sur qui les deux Alibamons s'empressèrent aussitost de tirer; mais les François, qui n'avoient pas encore tiré leurs coups, au lieu de tirer sur les bœufs, tournèrent leurs armes contre les deux Sauvages et les tuèrent tous les deux, et, après qu'ils leur eurent enlevé leurs chevelures, comme c'est la coustume de la guerre en ce pays-là, ils s'en allèrent fort loin se cacher dans le bois pendant tout le reste du jour, emportant avec eux les deux fusils des Sauvages et tout ce qu'ils avoient sur eux. Quand le jour fut fini, ils marchérent toute la nuit et arrivèrent au bout de trois jours à la Mobile, ou ils racontèrent à MM. d'Artaguiette et de Bienville ce qui leur estoit arrivé, et pour marque ils leur montrèrent les chevelures et les fusils des deux Sauvages." (pp. 479–480).

At least Pénicaut knew a good story when he saw one. Eight leagues would be between 20 and 25 miles and, therefore, if the original encounter were some distance from Pensacola, the bison may have been met on the Alabama side of the present state line. In any case it was not far from Florida. The same writer saw spoons made of bison horn and bison robes in the dwellings of the Pascagoula Indians on the river that bears their name (Margry, vol. 5, pp. 388–391) and in Iberville in 1699, saw bundles of bison skins in the temple of the Bayogoula Indians below the present Baton Rouge, Louisiana (ibid., vol. 4, pp. 169–172). These were outside of Florida but at not much higher latitudes. I am of the opinion that more cases will turn up with further examination of the earliest documents.—JOHN R. SWANTON, *Bureau of American Ethnology, Smithsonian Institution, Washington, D. C.*

CORRECTION

In the Journal of Mammalogy, vol. 16, No. 4, p. 329, 1935, under the title, "New mammal records for Mammoth Cave National Park, Kentucky," I reported the presence of

Microtus pennsylvanicus pennsylvanicus (Ord). The specimens upon which this identification was based are those of *Microtus ochrogaster*. I am indebted to Mr. Robert P. Holland, Superintendent of Mammoth Cave National Park, for the loan of the specimens for reexamination.—CLAUDE W. HIBBARD, *Kansas University Museum, Lawrence, Kansas.*

REVIEW

Grinnell, Joseph. MAMMALS OF DEATH VALLEY. Proceedings of the California Academy of Sciences, volume 23, number 9, pp. 115–169. 1937.

This recent paper deals only with 26 mammals found in the portion of Death Valley below sea level, being the results of studies made on three different expeditions beginning in 1917. No effort was made to incorporate facts gleaned from other published reports. The collection on which the report is based comprises 305 specimens representing 25 of the 26 species known to date—all of them except *Homo*. "Observations upon the Bird Life of Death Valley" (Proc. Calif. Acad. Sci., vol. 13, pp. 43–109) was published in 1923.

Among the general conclusions are the following: Mesquite growths are productive of the greatest amount of animal life. Eleven mammalian habitats, each occupied by a separate plant-animal association are designated. Even on this driest of dry deserts, few mammals seem to have any need of free water. It is probable that bats and carnivores require water, at least occasionally. Only man and bighorn sheep appear to be water-dependent. Vegetation is the fundamental food source, here as elsewhere. High numerical abundance of rodents was shown as a result of a 20 per cent yield from a trap line, when 85 mammals, representing 8 species, were captured during 430 trap-nights on one line.

"The great increase in number of people within the past few years who visit Death Valley (40,996 in the season of 1934–35, October 1 to June 30) raises the question as to what influence this human invasion each winter may ultimately have upon the native animal life. Happily, Death Valley has been constituted a National Monument, to be administered under the National Park Service. This means that in normal course, under the fixed policy of this Service, there will be no more hunting or trapping of animals. . . .

"With Death Valley made into a National Monument and rendered easily accessible in all its parts to visitation, *if* all its natural attractions are to be preserved, then a certain definite measure of wild life management must at once be practiced there, with all of the above ecological principles heeded."

It is not often that a scientific report departs far enough from orthodox recounting of fact to make comments on wild life management, but this paper does. With a view to helping toward the establishment of such management adapted to the conditions peculiar to this area Dr. Grinnell makes a number of practical suggestions, including the development of flowing water from as many seepages, springs, and wells as possible; posting of signs warning tourists and campers not to cut or injure any living mesquite, screwbean, or arrow-weed—plants that the animal population is dependent on for their subsistence; prohibition of all hunting and trapping; establishment of watering places for mountain sheep; and disposal of kitchen garbage at some distance from the Inn to attract interesting animals night and morning.

With most of these suggestions the reviewer agrees but, unfortunately, the emphasis on preventing developments so as to favor natural conditions has been forgotten in the proposal to furnish man-made "tanks" for sheep and the placing of garbage to attract animals. Experience in the national parks has shown that artificially fed ani-

mals become domesticated and subject to disease and in all respects poor examples of the unspoiled animals who live a normal life. There may be instances in park areas where animals should be attracted to feeding places to allow observation by the visitor, but this must be done sparingly and with caution and not practiced generally. From the standpoint of what is good for the animal, it is always bad practice because of the rich and unaccustomed food furnished and the resultant concentration of individuals.—HAROLD C. BRYANT.

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OBITUARY NOTICES

MADISON GRANT

The passing of Madison Grant on May 30, 1937, removed from the ranks of the conservationists one of their staunchest champions. Deeply interested in the preservation and perpetuation of threatened fauna and flora, he could always be expected to raise financial as well as moral support in any given crisis.

He was born November 19, 1865, and as his parents were wealthy, he had the advantages of good education and travel, as a youth. In his later years, his training in the classics was a matter of especial pride to him, and one of the projects left unfinished at his death was an account of the early geographic ranges of Old World mammals compiled from such sources as the old Greek scholars and the Niblungenlied. He was fond of debating such topics as the source of Hannibal's elephants, which he believed were secured in North Africa and represented a species now extinct. His father took him, when a boy, to the ruins of ancient Troy, where he sat on the crumbling walls and chanted Homer's Iliad. These scholarly attainments were manifested in the perspective of the man and his writings.

Madison Grant was trained as a lawyer, graduating from Columbia University Law School in 1890, but apparently the law could not hold his undivided attention, and he found greater interests in other activities. For example, he went to Alaska in the days of the early gold rush, where, as he has told me, the chief return from the sojourn was experience. He brought back with him from Alaska a great admiration for the wild life of that region, and maintained that appreciation of the Alaskan fauna throughout his lifetime. As an expression of this interest, he was instrumental in promoting the field work of Andrew J. Stone who, early in this century, made large and important collections of mammals on the Alaska Peninsula, the Kenai Peninsula, southern Alaska, and British Columbia. The late Dr. J. A. Allen described many new species of mammals based upon the series taken by Stone, and one of these he named after Madison Grant, *Rangifer granti*, the caribou of the Alaska Peninsula. Many years later Madison Grant was an active advocate for better protection for the large bears of Alaska and gave his full support to the proposal of a sanctuary on Admiralty Island.

An active, out-door man until he came to middle age, the onset of chronic arthritis eventually crippled him until he became a wheel-chair invalid. Such a handicap must have been especially irksome to one with his love of the great open spaces, but such was his courage that his friends never heard him complain, nor did he permit the disease to hold him back mentally. From his bed and his wheel chair he still kept alive his wide interests which touched upon so many noteworthy undertakings.

He was a pioneer in the establishment of the New York Zoological Society, chartered in 1895. From its inception, he was active in building up this institution and extending its sphere of usefulness. He served on the board and for many years was its president. He was also a valued trustee on the board of the American Museum of Natural History. He was president, for many years, of the Boone and Crockett Club and took a prominent part in guiding the conservation policies of this group of sportsmen and nature lovers. He belonged to many other scientific institutions and societies, and because he had such a wide range of contacts and enjoyed the confidence of such a broad circle of friends, he exerted an influence for conservation that has probably been exceeded by no other individual in private life.

The success of the "Save-the Redwoods" League, formed by Madison Grant, the late Professor H. F. Osborn and Dr. J. C. Merriam, was a graphic demonstration of the forces that could be brought to bear by Madison Grant and his friends.

His energies found another outlet in plans for public betterment when he became president of the Bronx River Parkway Commission which completed the beautiful highway of that name, an efficient and scenic parkway for which thousands of motorists are daily grateful.

Madison Grant was a charter member, also a life member, of the American Society of Mammalogists and a generous supporter of the Society's activities. He was chairman of the special committee which raised the J. A. Allen Endowment Fund, and was a member of the Committee on Conservation of Land Mammals. He assisted the Society's Committee on Problems of Predatory Mammal Control in raising funds for field study, and he was always ready to give a sympathetic ear to any conservation problem brought to him by a Society member. Not only was he prepared to give his personal support for the attack upon such problems, but through his connections he would see that supporting resolutions or actions were taken by the New York Zoological Society and the Boone and Crockett Club. He was the nestor of American conservationists, the wise counselor to whom one turned first when a conservation crisis impended.

He was an ardent disciple of Galton and his most extensive writings deal with human genetics, eugenics, and the dispersion of peoples. Two of his books, "The Passing of a Great Race" and "The Conquest of a Continent" proved to be storm centers of controversy because Madison Grant was fearless and outspoken and wrote exactly as he believed. His frank discussions of "Nordic superiority" and racial maladjustments were certain to evoke spirited response, but his was not a nature to forego a thrust for fear of a riposté.

Madison Grant numbered among his publications several titles on mammals but none of these are very long. Among these might be mentioned, The Caribou, The Moose, The Rocky Mountain Goat, and The Origin and Relationship of the Large Mammals of North America. A favorite subject for discussion during his last few years, and one on which he had begun to publish, was the "Vanished game of yesterday."

By the death of Madison Grant the American Society of Mammalogists loses one of its most distinguished members and well-wishers; conservationists, naturalists, and nature lovers throughout the world lose one who never neglected an opportunity to plead their case against the attacks of special privilege; and his many friends will miss all these things and more, for the attributes of Madison Grant made his friendship something that one can not soon forget.—H. E. ANTHONY.

GEORGE BIRD GRINNELL

George Bird Grinnell, a charter member of the American Society of Mammalogists, died at his home in New York City on April 11, 1938. He was born in Brooklyn, New York, on September 20, 1849, the son of George Blake and Helen Lansing Grinnell. Among his ancestors were five Colonial governors and Betty Alden, the first white woman born in New England. Surviving him are his wife, the former Elizabeth Kirby Curtis, and a sister, Mrs. Newell Martin, of Huntington, Long Island.

At an early age he moved with his parents to that section of New York City then known as Audubon Park, which at that time was far out in the country. Here he attended school under Madam Audubon, widow of John James Audubon, who exerted a benign influence on the boy and no doubt aroused in him a love for those things that held his attention in later years. He was graduated from Yale University in the class of 1870.

In June of the same year he set out with Professor O. C. Marsh on an expedition to the then Far West for the purpose of collecting vertebrate fossils. This trip was the forerunner into a region that provided him a life-long interest and afforded material

that came to light in so many of his published works. Subsequent trips were made with Col. William Ludlow to the Black Hills in 1874, as naturalist on the expedition led by General Custer, and to the Upper Missouri and Yellowstone Park regions in 1875.

He was assistant in osteology at the Peabody Museum in New Haven, Connecticut until 1880, when he became editor of Forest and Stream, a weekly magazine devoted to outdoor subjects. Here Dr. Grinnell came into his own. For the next 30 years he labored for the conservation of our natural resources as no other man has ever done. His magazine became the outstanding journal for accurate and painstaking contributions on natural history matters. It was a vital force in conservation. It was replete with interest for those who loved the outdoors and venerated natural objects. It reflected the talents and deep-seated desire of its editor to be of service to all worthwhile projects. Through its columns he attacked the enemies of Yellowstone Park and saved that great recreational ground for the people of the nation. He awakened the public conscience and saved many of our most valuable game animals and birds from extinction. Conservationists throughout the country became aroused and the slaughter of elk, antelope, buffalo, and deer was checked.

In 1886 he organized the first Audubon Society and published a little magazine that called attention to the ruthless destruction of our song birds. This initial movement paved the way for the state Audubon Societies, and later for the National Association, which have done so much for the bird life of the country. He was a member of the Board of Directors of the National Association of Audubon Societies for 26 years and his wise and valuable counsel was eagerly sought and generously given.

In 1887 he was one of the founders of the Boone and Crockett Club and became its president in 1918, succeeding such men as Theodore Roosevelt, Benjamin Bristow, and William Austin Wadsworth. When he retired in 1927 he was made its honorary president for life. No body of men has done more for the protection of our wild-life. The books published by this club comprise some of the most valuable contributions to the literature of clean sport and virile activities extant. Dr. Grinnell was co-editor with Theodore Roosevelt of the first three volumes and assumed the chief editorship of the remaining four.

He was a member of the famous Harriman Expedition to Alaska in 1899, which added so much to our knowledge of that interesting region. Among his fellow voyagers were John Burroughs and John Muir. He contributed largely to the volumes published on the work of this expedition.

In 1911 he was instrumental in founding the American Game Protective Association, which promoted the interest of game conservation during a very important period of wild-life adjustment, and now has been taken over by the American Wild-life Institute.

It was mainly through the efforts of Dr. Grinnell that Glacier National Park came into being. He had made many trips into this wonderful region with his friends the Blackfoot Indians, and later it was the scene of numerous hunting trips. He became so enamoured with its beauty that he brought it to the attention of the public through the columns of Forest and Stream and other magazines, urging that it be set aside as a national park. This was finally accomplished in 1910. When he was awarded the Roosevelt Memorial medal in 1925 for distinguished service, President Coolidge, having in mind his great work for the preservation of Yellowstone Park and for the creation of Glacier Park, said: "Few have done so much as you, and none has done more, to preserve vast areas of picturesque wilderness for the eyes of posterity in the simple majesty in which you and your fellow pioneers first beheld them".

The wealth of Dr. Grinnell's literary attainments is astounding. Several years ago his secretary, Mr. Sheetz, started to make a list of titles which, when completed, will comprise a vast number of subjects. His contributions to popular and scientific magazines alone would fill many volumes and cover a wide range of topics. He was a frequent contributor to the Journal of Mammalogy and always had a deep interest in the

affairs of the Society. He was a Fellow of The American Ornithologists' Union and wrote often for its official organ, The Auk. Sportsmen revere him for his "American Duck Shooting" which appeared in 1901 and still is the best book on that subject, while his "American Game-Bird Shooting" remains as popular as ever after 28 years of reprinting.

The books he wrote for boys, depicting life in the west, are eagerly read by each succeeding generation and contain such a rich store of accurate information that they still delight many a seasoned outdoor man. It is a strange commentary that during the last few years, while he was waiting so patiently for his advent into a fuller life, his mind reverted to the writing of these books for boys and his secretary spent many hours reading aloud to him from "Jack the Young Canoeman", "Jack in the Rockies" and others in the series.

In all he published 26 books and edited many more. His first book, "Pawnee Hero Stories and Folk-tales" was published in 1899, and "Blackfoot Lodge Tales" appeared in 1892. These books at once established his reputation as a student of Indian life and customs. During the next 25 years he continued to make yearly visits to the lodges of the Blackfeet, Cheyennes, Pawnees and other Plains Indians, interviewing their old chiefs and making copious notes on their folk-lore. Because of this laborious and unselfish work he saved for posterity a true account of the old-time ways of our vanishing redmen. These notes were later incorporated in his monumental works of which "The Cheyenne Indians, Their History and Ways of Life" is probably his greatest contribution to literature. Other books written by Dr. Grinnell include "The Fighting Cheyennes", "The Story of the Indian", "Punishment of the Stingy", "Trails of the Pathfinders", "The Wolf Hunters", "When Buffalo Ran", "By Cheyenne Camp-fires", and his last one, "Two Great Scouts and their Pawnee Battalion", which commemorated the exploits of his life-long friends, the famous North brothers.

George Bird Grinnell lived such a full life of outstanding usefulness that it is hard to find any one field of endeavor connected with the affairs of wholesome living in which he did not excel. Anything that tended to make the world a happier place in which to live attracted his interest and he gave full measure of time and energy to bring such endeavors to a practical and successful conclusion. His was a sane and healthy outlook on life. He had little patience for extremists or for those who followed false teachings. Remarkable for his modesty, strong in his faith and glorious in battle he will always be remembered for the inspiration that he gave to those who worked by his side for the betterment of mankind.—JOHN P. HOLMAN.

COMMENT AND NEWS

A. Brazier Howell, Department of Anatomy, Johns Hopkins Medical School, Baltimore, Maryland, is engaged upon an investigation of the specialization of vertebrates for a cursorial existence. He is anxious to secure accurate records of rate of speed, length of stride or leap, of any sort of mammal or other sort of vertebrate.

Recently we have been informed that Mexico has revoked the concession, operative during the last year, for the conversion of sealions into cat and dog food. It has been impossible to ascertain the exact number of animals killed for this purpose, but an Associated Press dispatch has placed the total at "more than 20,000." Sealions are abundant along the coast of Lower California but they could hardly withstand for long any such drain upon their numbers. Although highly unpopular with fishermen, there is likelihood that the California sealion has a diet that is actually of economic benefit to fishing interests, and Mexico is wise in prohibiting for the present the heavy utilization of this wildlife resource.